aeroQUAL

Aeroqual
Dust Sentry
User Guide

Aeroqual Limited
109 Valley Road, Mt Eden,
Auckland 1024, New Zealand
Phone: +64 9 623 3013
Fax: +64 9 623 3012
Web: www.aeroqual.com

Table of Contents

User Guide Revision History **4**

1. Description **5**
1.1. Nephelometer 6
1.1.1. Electrical connections to Nephelometer 6
1.1.2. Inlet heater 6
1.1.3. Inbuilt filters 6
1.2. Pump Module 7
1.3. Control Module 7
1.4. Power Module 8
1.5. Auxiliary Module (Optional) 8
1.5.1. Wiring of Auxiliary Module 9
1.6. Analogue Output Module (Optional) 10
1.7. Gatetel GT-HE910_G Cellular Terminal (Optional) 10
1.7.1. Specifications 11
1.8. Electrical Connections 11
1.9. Alarm Relay 12

2. Assembly and Installation **13**
2.1. Assembly of heated inlet 13
2.2. Connect Mains Power 14
2.3. Sample Collection Filter (Optional) 15

3. Dust Sentry Operation and Software **16**
3.1. Getting Started 16
3.2. System Checks 18
3.3.1. Further information about IP address solutions using GPRS Systems 20
3.3.2. Email Message 20
3.3.3. SMS Message 21
3.4. Software Description Summary 21
3.4.1. File 21
3.4.2. Setup 23
3.4.3. Data 23
3.4.4. Tools 24
3.4.5. Calibration 24
3.4.6. Diagnostics (Available in Engineer Mode) 24

4. Maintenance **26**
4.1. Maintenance Schedule 26
4.2. Maintenance Procedures 26
4.2.1. Sample Flow Check 26
4.2.2. Zero Air Check (Purge Cycle) 27
4.2.3. Sheath Flow Check 28
4.2.4. Leak Check 28
4.2.5. Manual Zero Air Check 29
4.2.6. Fibre Span Check 29
4.2.7. Laser Current Check. 29
4.2.8. Filter Changes 29
4.2.9. Cyclone and Inlet Cleaning 30
4.2.10. Pump Module Removal 30

5. Calibration **31**

6. Troubleshooting 32

7. Specifications 34

8. Schematic Diagrams 35
8.1. Pneumatics 35
8.1.1. Sample Mode 35
8.1.2. Zero Mode 35
8.2. Electrical 36
8.3. Communication 36

9. Third Party Sensors 37
9.1. Sensirion T/RH Sensor SHT75 37
9.2. Gill WindSonic 37
9.3. Met One 034B 37
9.4. Met One MSO 38
9.5. Vaisala Weather Transmitter WXT520 39
9.6. Cirrus MK:427 40

10. Mounting and Site Positioning Guidelines 41
10.1. Mounting 41
10.2. Inlet height 41
10.3. Measurement Interference 42
10.4. Safety 42

11. Orbit Data 43
11.1. Specifications 43
11.2. Configuring the Orbit Modem 43
11.3. Using the Orbitdata Website 44
11.3.1. Using the Graphs 45
11.3.2. Setting Alarms 46
11.3.3. Downloading Data 46

12. Appendix 47
12.1. Warranty 47
12.2. Technical Support 47
12.3. Declarations 47

User Guide Revision History

Document Number: MRK-D-0014
Product Version: 1.2
Document Version: 4
Date released: March 2013
Description: User Guide for Dust Sentry

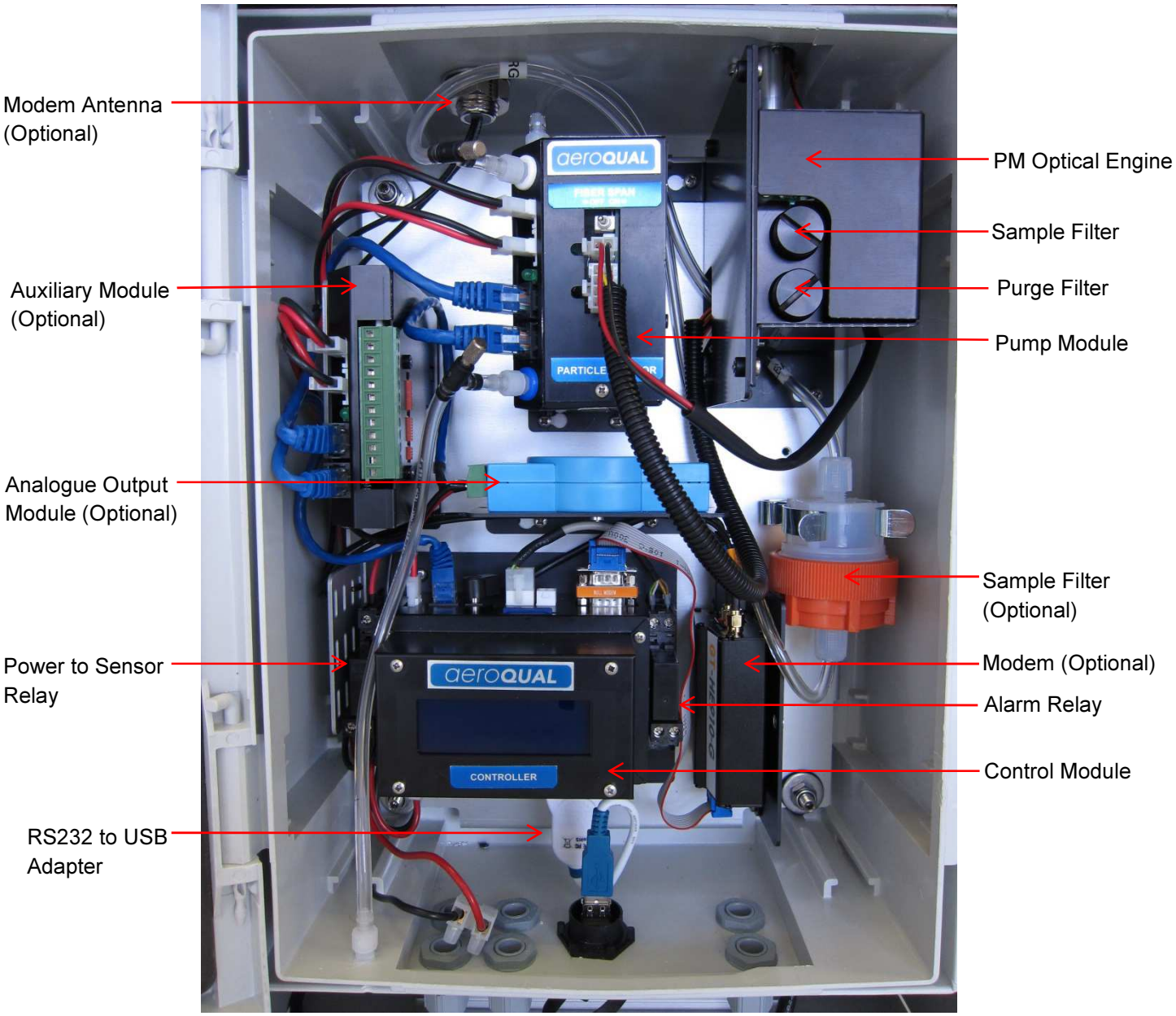
This User Guide is a newly created document for the use of the Aeroqual Dust Sentry.

Date	Revision number	Description of change	Affected pages
May 2011	V1	Initial draft	
March 2013	V2	Improved accuracy and readability	All
August 2013	V3	Updated for DS 1.2	All
October 2013	V4	Added information on Orbit Data and Gatetel Modem	Pg. 10-11 and Pg.44-47

1. Description

Aeroqual's Dust Sentry is a user friendly instrument designed to provide reliable real time indicative particulate measurement of PM10, PM2.5 or PM1 using a well proven near forward light scattering nephelometer and high precision sharp cut cyclone.

The instrument includes an integrated internal data logger, alarm relay outputs and a SD card as standard. There are also numerous additional options available, including, wireless communications, SMS and email notifications, weather sensors and GPS. The instrument is packaged in a robust, lockable enclosure and is light enough for one person site installations. The ease of installation, as well as the extensive range of possible add-ons, enables the unit to be used in a wide range of applications.



Note: 12 VDC Power Supply mounted externally at base

The key components of the Dust Sentry are described below.

1.1. Nephelometer

Aeroqual uses a Nephelometer optical sensor from Met One Instruments. The optical sensor uses light scattering from particulate matter to provide a continuous real-time measurement of airborne particle mass. The light source is a visible laser diode and scattered light is measured in the near forward angle using a focusing optics and a photo diode.

The Nephelometer has an on-board temperature sensor which corrects for thermal drift, sheath air filter to keep the optics clean, automatic baseline drift correction and a fibre optic span system to provide a check of the optical components.

Safety: This sensor is considered a Class I laser product. Class I laser products are not considered to be hazardous. There are no user serviceable parts inside the cover of the sensor. The device contains a laser operating at 670 nm which is visible to the eye and can cause damage to the eye if directly exposed. Only trained service personnel should attempt servicing or repair of the sensor.

1.1.1. Electrical connections to Nephelometer

The electrical connections to the Nephelometer are summarised below:

Wire colour	Function
Orange (x2)	Fibre optic solenoid
Red	5V (power in)
Black	Ground
White	Signal out (0-5 V)
Black/white	Signal Ground
Yellow	Laser current monitor (10mV = 1 mA laser current)
Grey	Temperature output

1.1.2. Inlet heater

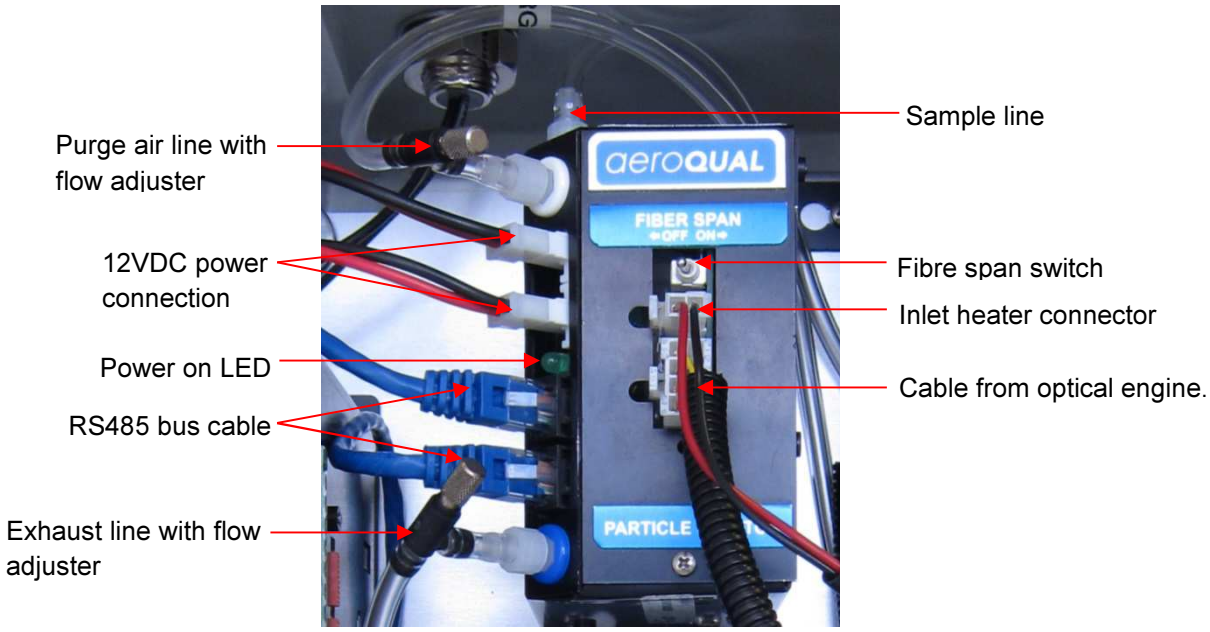
The Dust Sentry uses a 12 V heater on the sample inlet tube to reduce the humidity of sampled air to prevent particle growth and fogging of the Nephelometer optics in high RH conditions. The inlet should always be heated.

1.1.3. Inbuilt filters

The Nephelometer contains two filters which should be replaced at specified intervals (see Maintenance Section 4). The “Sample” filter is a coarse filter designed to protect the sample pump from excessive particle build-up. The “Purge” filter is a fine filter which filters the sheath air flow and also produces particle-free air during the auto-zero cycle.

1.2. Pump Module

The Pump Module contains a microprocessor for mass calculation and a pump for sampling. The schematic is shown in Section 8.

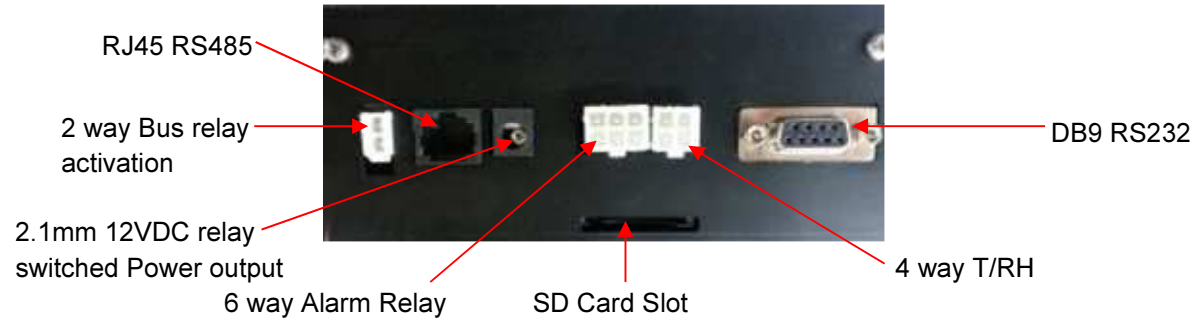


1.3. Control Module

The control module is the interface between the RS485 sensor bus and data communication links. It contains a display, an SD data card which logs data, a RS232 serial connector for external communication, a bus connector for internal communication with the sensor modules and a cable connector for the optional Humidity and Temperature sensor (if fitted).

Front

Top



Bottom

Controller 12VDC power input
Off/On switch with LED. Depress to power on (blue LED on)
Programming Port RS232
Programming Dip Switch (position is important)

The Dust Sentry is supplied with a RS232 to USB adapter fitted between the Control Module and an external USB socket fitted at the base of the enclosure. This enables the user to perform a wide range of functions over the USB connection, without needing to open the enclosure door, such as data logging and various system checks using the supplied Aeroqual Dust Sentry PC software

Note 1: The driver for the RS232 to USB adapter is in the software CD which comes with the instrument.

Note 2: The power to sensor and alarm relays are also attached to the control module base plate.

1.4. Power Module

The Dust Sentry internal power requires regulated 12 VDC to maintain a constant pump speed. An external mains to 12VDC power supply (Meanwell HLG80-12A 60W 12V) is fitted on the outside of the enclosure and this will allow connection to mains supply.

Note: If you wish to run the Dust Sentry on solar power you will need to use a DC-DC convertor in order to supply a regulated 12 VDC for the Dust Sentry – refer to the application notes on the website

1.5. Auxiliary Module (Optional)

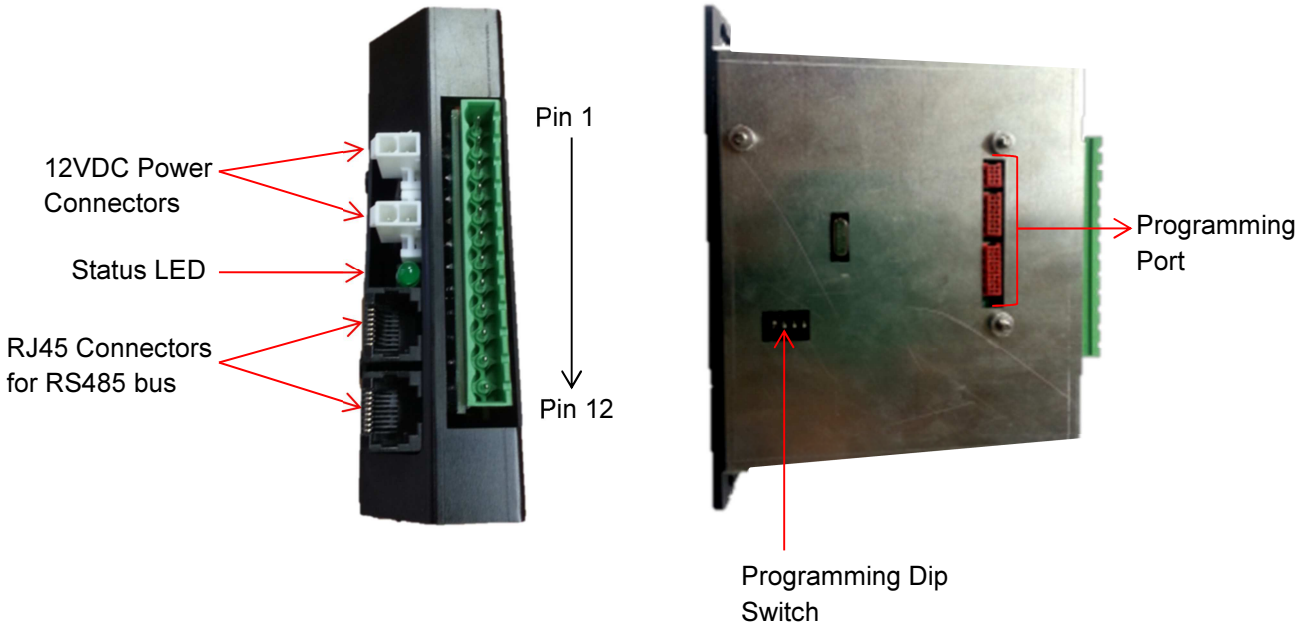
The auxiliary module acts as an interface between third party sensors and the Dust Sentry communication bus. It is configured with different operating modes which can be selected by using the dipswitches located on the side of the module. Aeroqual has integrated a number of third party sensors and is able to supply the auxiliary module preconfigured for your sensors.

Firmware: AUX_MODULE_01.
Use for: Analogue inputs, Vaisala WXT520 weather, Gill Windsonic wind, Cirrus MK:427 noise.

1	2	3	4	Function
OFF	OFF	OFF	OFF	Default - standard Auxiliary module with AN1, AN2, Freq
ON	OFF	OFF	OFF	Vaisala WXT520 with RS232 communication + AN1, AN2, Freq
OFF	ON	OFF	OFF	Vaisala WXT520 with RS232 communication + Cirrus MK427 Noise
ON	ON	OFF	OFF	Wind Sonic with RS232 communication + AN1, AN2, Freq
OFF	OFF	ON	OFF	Wind Sonic with RS232 communication + Cirrus MK427 Noise
ON	OFF	ON	OFF	Cirrus MK427 Noise module only

Firmware: AUX_MODULE_02.
Use for: Analogue inputs, Met One MSO weather, Met One 034b wind, Cirrus MK:427 noise.

1	2	3	4	Function
OFF	OFF	OFF	OFF	Default - standard Auxiliary module with AN1, AN2, Freq
ON	OFF	ON	OFF	Cirrus MK427 Noise module only
OFF	ON	ON	OFF	Met One MSO with RS232 communication + Cirrus MK427 Noise
ON	ON	ON	OFF	Met One MSO with RS232 communication + AN1, AN2, Freq
OFF	OFF	OFF	ON	Met One 034B analogue module + Cirrus MK427 Noise



1.5.1. Wiring of Auxiliary Module

PIN 1: GND
PIN 2: 12V FUSED
PIN 3: RESERVED
PIN 4: RESERVED
PIN 5: RX
PIN 6: TX
PIN 7: 0-5V IN
PIN 8: 4-20mA IN
PIN 9: FREQ IN
PIN 10: AGND
PIN 11: METONE 034B PWR
PIN 12: TIMED RELAY

Example of wiring:

Wind Sonic	(Pin 1) GND, SIGNAL GND	(Pin 2) 12V	(Pin 5) RX	(Pin 6) TX
Vaisala	(Pin 1) GND for operating, data & heating	(Pin 2) 12V for operating & heating	(Pin 5) RX	(Pin 6) TX
Met One MSO	(Pin 1) GND, SIGNAL, COMMON, SHIELD	(Pin 2) 12V	(Pin 5) RX	(Pin 6) TX
Met One 034B	(Pin 1) GND	(Pin 12) VCC	(Pin7) WD	(Pin 9) WS
Cirrus MK:427	(Pin 1) GND, ACTUATOR GND	(Pin 2) 12V, LOOP IN	(Pin 8) LOOP OUT	(Pin 12) ACTUATOR IN

A programming port is also exposed through the side of the module to allow custom programs to be loaded into the module.

Note: Aeroqual can supply a standard programming tool for distributors to reprogram the auxiliary module to the specified requirements.

1.6. Analogue Output Module (Optional)

The Dust Sentry has the option to integrate an ADAM 4021 Analogue Output Module into the system to allow for the digital inputs of a chosen sensor to be converted to an analogue output. The analogue output module receives the digital input via an RS485 interface and converts it to a 4-20mA and 2-10V output. These outputs follow each other.

Outputs:
4mA (2V) = 0% of full scale value.
12mA (6V) = 50% of full scale value.
20mA (10V) = 100% of full scale value.

The module is easily configured via the Operations menu in the PC software and can convert to an analogue output any chosen sensor already integrated in the Dust Sentry. The module uses the logging period to calculate the reading, which is also set in the Operations menu. This differs from the alarm relay, SMS and email which all use the averaged alarm period to calculate the reading. For more information regarding the PC Software and setting up the analogue output module please refer to Section 3.1.

1.7. Gatetel GT-HE910_G Cellular Terminal (Optional)

Aeroqual can provide a Gatetel GT-HE910_G Cellular Terminal with GPS for remote data access over GSM, GPRS or SMS networks. Please read the Gatetel GT-HE910_G Cellular Terminal manual for detailed instructions on configuration and use. Further information can be found at:

http://gatetel.com/products.php?product=22

1.7.1. Specifications

Features	
Incorporates Telit HE910-DG module	The Telit module handles all GSM/UMTS GPS processing with PYTHON script
Frequency bands	GSM: 850/900/1800/1900MHz UMTS/HSPA+: 800/850/900/1700/1900/2100MHz
Power supply	Single supply voltage 6V DC to 55V DC connector 4 pin micro-fit 3mm
ADC and GPIO inputs	Two outputs optocouplers open collector drive 100ma Two inputs optocouplers, 0-55v One ADC 10 bit , 0-55V connector 6 pin micro-fit 3mm
Communication	Modem Full RS232, connector D-Type 9pin (DB-9) Modem USB, Connector USB Type B High retention
Antennas	GSM/UMTS GPS via SMA connectors
Mechanical Description	
Weight	180g (6.35oz) 0.4 lb
Dimensions(max) L x W x H	83mm x 64mm x 34mm 3.26inch x 2.51inch x 1.33inch
Case material	Aluminum
Environmental Requirements	
Operating temperature range	-20°C to +55°C -4°F to 131°F Ambient temperature *The module is fully functional in all the temperature range and it fully meets the ETSI specifications.*
	-30°C to +70°C -22°F to 158°F *The module is fully functional (*) in all the temperature range. Temperatures outside of the range –20°C to +55°C (-4°F to 131°F) might slightly deviate from ETSI specifications.*
Humidity	5% - 85%

1.8. Electrical Connections

RS485 Bus

The two wire RS485 bus connections are made using 20 cm CAT5 cables between the sensor modules. The last module on the bus also has a blue termination dongle fitted.

Note: If the optional Analogue Output Module is fitted the termination dongle is not fitted. Instead termination resisters are fitted in the RS485 cable that terminates at the Analogue Output Module.

12 VDC Power Bus

All modules inside the Dust Sentry operate from the 12VDC power. The power is supplied by a daisy chain of black and red cables. A relay is activated by the Control Module on/off button to allow the sensor bus to be powered.

12 VDC Power in

12 VDC power is connected into the instrument at the terminal connector strip (“chock bloc”).

1.9. Alarm Relay

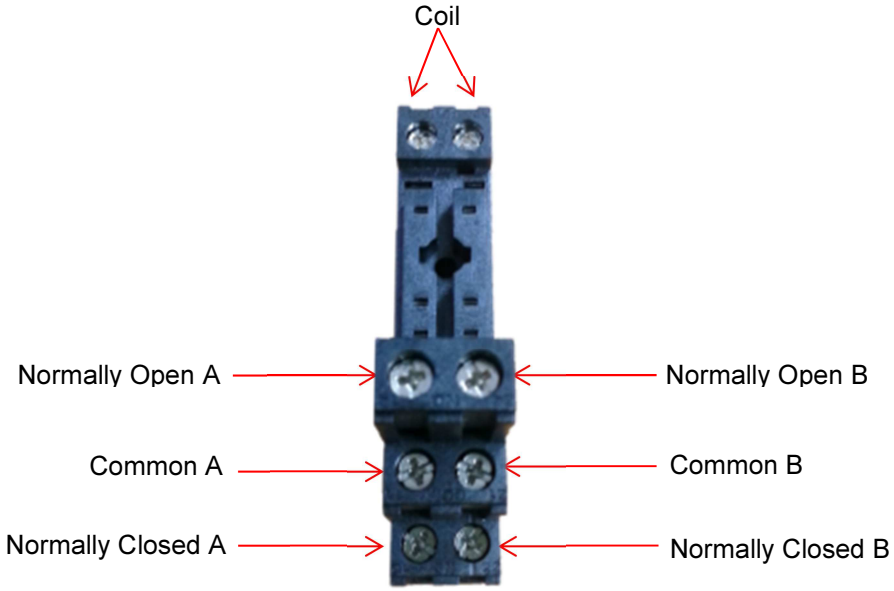
The Dust Sentry has a built in alarm relay function that is set up via the Operation Dialog in the PC software (See Section 3.1.)

Relay Output: This is fitted as standard and is activated by “Enable Alarm Relay Output” tick box. If the set point set in “Alarm trigger point” is exceeded the relay is activated. This can be used to activate a siren or strobe or other peripheral devices. The relay remains activated until the measured value drops below the reset point (expressed as a % of the trigger point). This is controlled via the “Alarm reset point of trigger”. The “Alarm trigger point average period” determines the amount of time that the concentration needs to be exceeding the trigger point before the relay is activated.

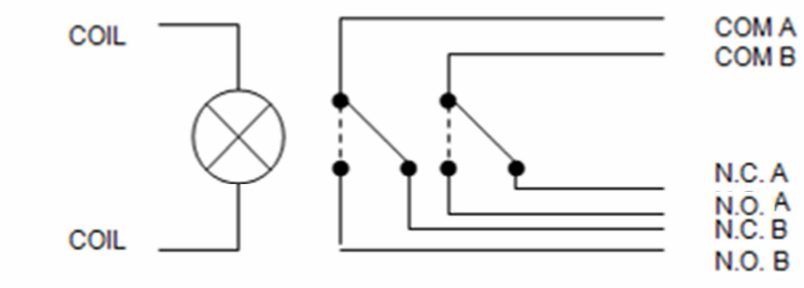
If “Active output on diagnostics” is selected the alarm will trigger upon sensor failure or sensor no report. If not selected the alarms remain in the state they were in when the last valid reading was logged.

The Alarm relay is energised by the Control Module in response to the alarm trigger point. The trigger point is programmed into the Control Module via the Operation menu in the PC Software. The Alarm Relay is a double pole; double throw type (see diagrams below). This allows the connection of two different alarm signals – e.g. siren and strobe - that may have different power requirements.

The relay contacts rating: 10A @ 24VDC 220VAC.



Relay Internal Schematic

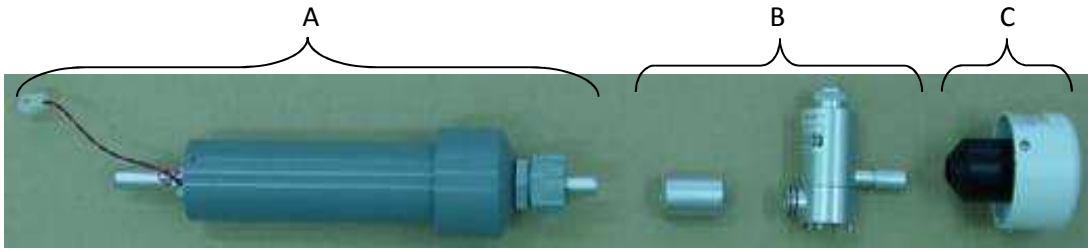


2. Assembly and Installation

2.1. Assembly of heated inlet

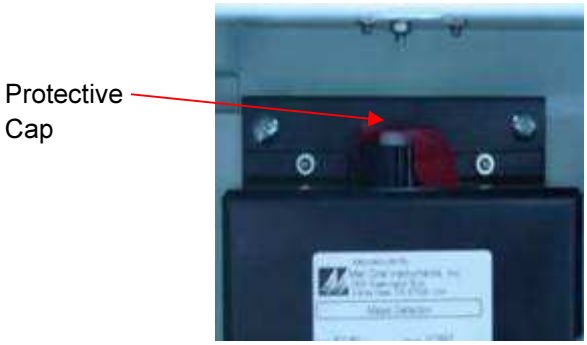
Parts List:

A. Inlet Tube/Heater including power cable
B. Sharp Cut Cyclone (if fitted)
C. TSP Inlet

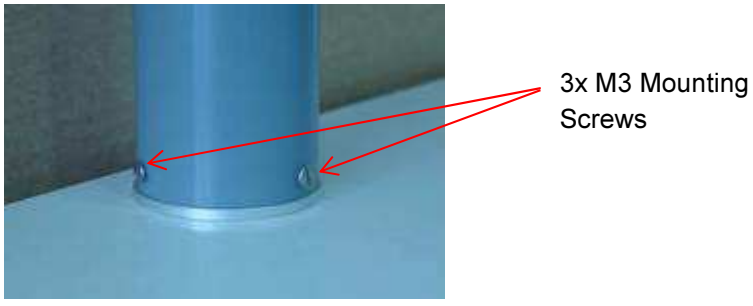


i. Connect parts A, B and C

ii. Open door of enclosure and remove protective cap from the optical engine



iii. Insert Inlet Tube Assembly through base mount and fix the three mounting screws



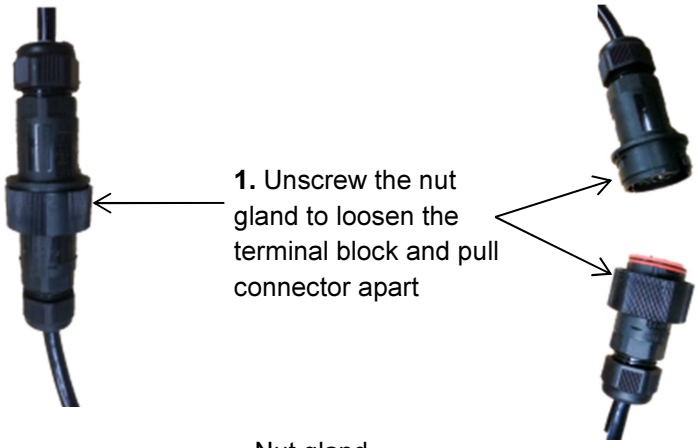
Note: Ensure the power cable is fed through the inlet hole when connecting

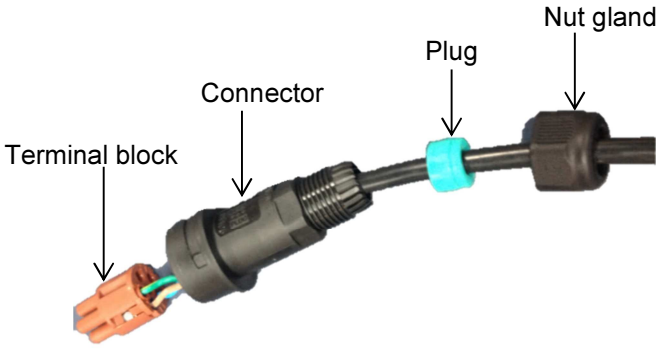
iv. Connect power to Inlet Tube/Heater inside the enclosure

2.2. Connect Mains Power

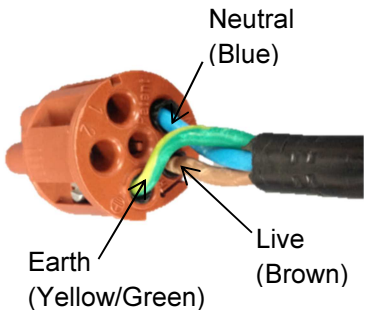
Caution: The high voltage mains supply must be wired by a certified electrician in compliance with local electrical regulations.

- Locate the power connector terminal which is situated outside the enclosure at the bottom. The power supply will already be wired to the connector however the cable to connect to mains power needs to be wired.





2. Feed the power cable through the nut gland plugs and connector and wire the cable to the terminal block according to the diagram.



3. Reconnect into the connector ensuring the plugs are fitted securely and the nut gland tightened.

Note: To remove the terminal block from inside the connector unclick it from the casing by turning it slightly then pull out

2.3. Sample Collection Filter (Optional)

The Dust Sentry can be fitted with a 47mm collection filter holder if requested. It is used to collect particulate samples for composition analysis.

Note: If the Dust Sentry is shipped with a sample collection filter holder, it will not contain a filter on arrival.

If you wish to use the sample collection filter:

1. Remove the internal sample filter from the 80180 optical engine (See 4.2.8)
2. Unscrew the collection filter housing and insert a 47 mm filter.
3. Tighten the collection filter housing.
4. Check and adjust the sample flow to 2.0 LPM

3. Dust Sentry Operation and Software

3.1. Getting Started

Computer Requirements

- CD-ROM Drive or internet connection for software download
- RS232 serial port or USB – RS232 serial port converter and USB cable (included)
- Windows OS version 2000 or later
- Minimum 100 Mb of spare hard drive space
- Recommended 512 Mb RAM or more
- Recommended 1 GHz processor speed or faster

1. Once the Dust Sentry is assembled and power is connected install the SD card into the control module.

2. Start the Dust Sentry by pushing the on/off switch on the control module (See Section 1.3 for location of On/Off switch)

3. Connect the instrument using a computer via the USB cable to the outside of the enclosure

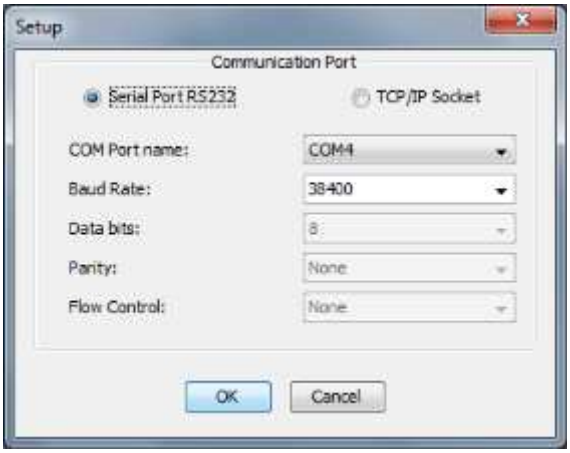
4. Install Aeroqual Dust Sentry software. **This can also be downloaded from the Aeroqual website at www.aeroqual.com**

5. Launch the Aeroqual Dust Sentry PC software.
    a. Select to log in as either:
        - User (default password = “password”)
        - Engineer (default password = “aeroqual”)

Note 1: **User has access to most day to day functions on the instrument. Engineer has access to all functions, including diagnostic parameters (Sensor Module Settings and Sensor Diagnostic View).**

6. Configure the Dust Sentry instrument:
    a. Select Setup → Communication Port
    b. Select Serial Port RS232 and the relevant Com port. Press OK when complete.

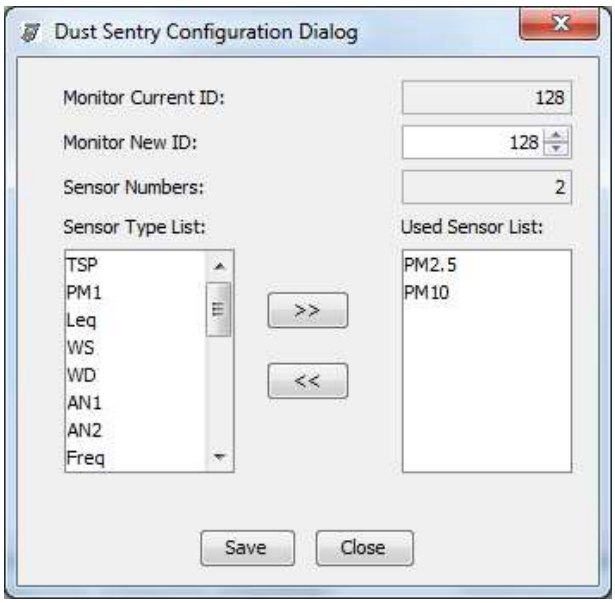
Note 2: The settings should be as seen below:



Note 3: To connect via the modem select TCP/IP Socket and enter the network IP address and port number. If the PC is behind a proxy server this information needs to be added as well.

7. Check configuration

- Select Setup → Configuration
- Check the correct sensors in the Dust Sentry have been configured.
- These should match the sensors on the invoice and the sensors list in the instrument logbook.
- Click Save and Close.



8. Set Dust Sentry Real Time Clock
   a. Click on Tools → Update Real Time Clock (this will synchronise the Dust Sentry clock with the computer date/time)

9. Configure the operations
   a. Select Setup → Operations.

   b. Enter Data Logging Period

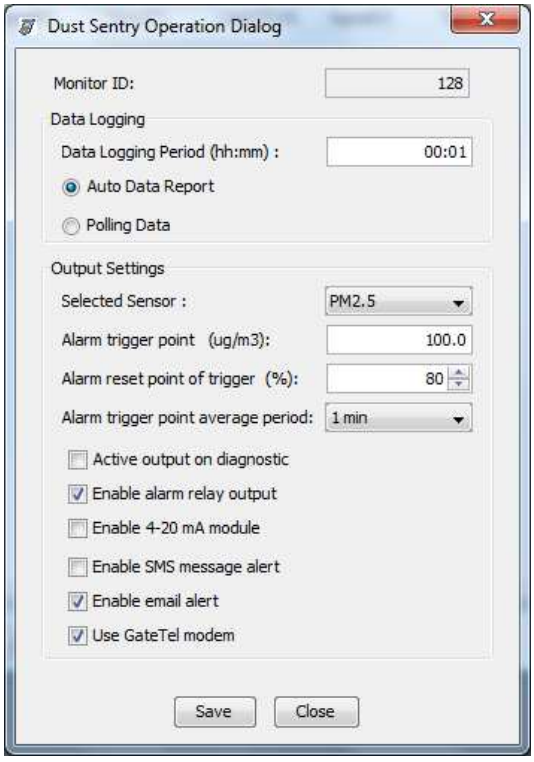
   c. If the alarm relay is being used please check "Enable Alarm Relay Output"

   d. Select the output sensor and set the Alarm trigger point. The alarm will go off when the concentration reaches above the concentration set for the selected sensor.

   e. Select the reset point of trigger. This is the percentage of the alarm trigger concentration at which the alarm will reset.

   f. Select the alarm trigger point average period. This signifies the time interval at which the average is calculated for control of the alarm.

   Note: The alarm average period must be greater than or equal to the data report rate



g. If the analogue output module is being used please select “Enable 4-20 mA module”. The module will follow the “Output Sensor” selected.

Note 1: If “Active on diagnostic” is set the analogue output will go to full scale upon No Report or Sensor Failure condition. If not selected the analogue output will remain in the state it was in when the last valid reading was logged.

Note 2: When the particle monitor zero calibration is taking place the analogue output module does not update, i.e. it remains in the state it was in immediately prior to the zero calibration. The module remains in this state until the zero calibration is finished, then updates on the next valid reading.

h. If the modem is being used please select “Use GateTel modem”. Once this has been checked the option to enable email and SMS message alerts will appear. (Refer to Section 3.3. for information on connecting and using the modem features)

10. Start data-logging to confirm sensor communication and operation is correct.
    a. Click Data → Table → Real Time to launch real time data table.
    b. Click File → Start Data logging. Data will start being displayed in Real Time Table.

3.2. System Checks

The following are a list of checks that should be performed to ensure the communications are working correctly and the data is being logged properly. If there is an issue with one of these checks please refer to Section 4 or contact Aeroqual for technical support.

1. With the Dust Sentry on, open the door and observe the display on the controller. This should be scrolling with sensor readings.

2. Connect a USB cable to the port on the Dust Sentry enclosure and connect to a PC running the Dust Sentry PC software. Confirm that you can communicate correctly with the instrument.

3. Verify the Dust Sentry is data logging correctly to the SD card by clicking “File → Download Files” on the PC software. A daily log file (DLYYMMDD.AQL) containing the DUST SENTRY sensor data is created each day. Also system events such as power on, configuration updates, calibration events and system faults are logged to an EVENTLOG.AQL file.

4. Confirm that the Real Time Clock setting and Configuration is correct.

5. Confirm all of the sensors installed in the Dust Sentry are logging onto the SD card log files and in the real time table in the PC software. If not check that all the sensors are loaded in Configuration menu

3.3. Modem configuration

If the Gatetel GT-HE910_G Cellular Terminal is purchased with the Dust Sentry it will need to be configured using the PC software. Firstly, the modem requires a suitable SIM card (not supplied) that matches the configuration.

Note: The SIM card needs to be pushed into the modem with the electronic tile facing upwards.

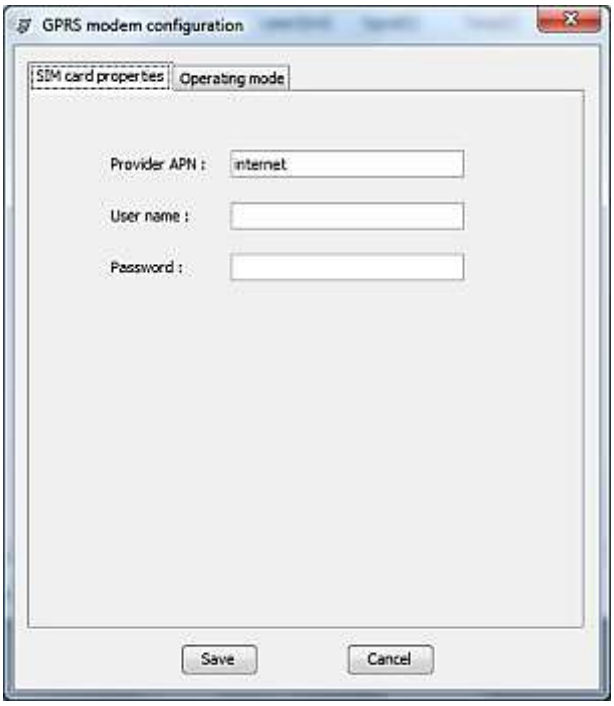
Configure

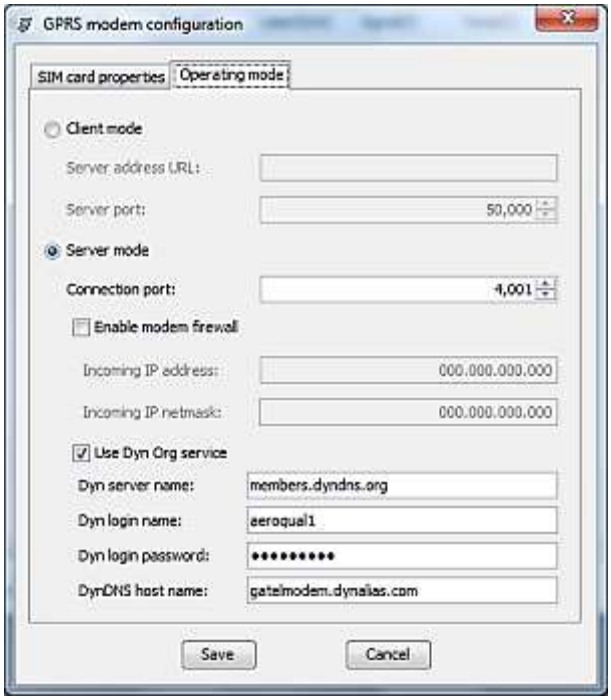
- Select Setup → Configure GPRS Modem
- Enter the SIM card provider's APN and username and password if applicable

Note: To use the modem in Server Mode requires an unrestricted APN that can accept connections

- Click save
- Select Operating mode and select one of the operating modes
- If using Dyn Org service:
  Dyn server name is: members.dyndns.org
  Dyn login name is: your account log in name
  Dyn login password is: your account log in password
  DynDNS host name is: the name you have configured for this instrument

Note: You must reboot the Dust Sentry after saving the Dyn Org parameters.





The modem has the following operating modes:

1. **TCP Client Mode:**
   - IP and domain name support
   - Destination address and port
   - Dust sentry connects to chosen server and data accessed via server.

Note: There is no remote access to the Dust Sentry using this mode, except via the designated server.

2. **TCP Server Mode:**
   - DDNS support for fixed or dynamic public IP addresses (using dyndns.org)
   - Optional firewall to restrict which IP addresses can connect to Dust Sentry
   - Set TCP port

3.3.1. Further information about IP address solutions using GPRS Systems

GPRS is a communication technology that allows data acquisition systems to overcome the difficulty of cabling for wide area remote sites. GPRS applications are becoming more prevalent, but the dynamic IP address issues associated with GPRS networking continue to frustrate system integrators.

The trouble with I/O devices with GPRS capability is that they receive a different IP address every time they connect to the GPRS network.

Three distinct solutions have been developed to overcome this challenge:

Solution 1: Public Static IP Address

The first option is to obtain a public static IP address; some carriers (telecom service providers) can assign a static IP address to a specific SIM card. This way, all the I/O devices will have their own static IP address. The main benefit of this solution is that it behaves like a wired solution. However, not all carriers offer this kind of service.

Solution 2: VPN Service Provided by Carrier/MVNO

A VPN (Virtual Private Network) is a secure LAN solution that groups specific devices together. The VPN grouping concept solves the dynamic IP address issues and prevents unauthorized persons from accessing the data. For this VPN solution, customers are required to buy one of a number of different GPRS on-line services to be able to access a Virtual Private Network (VPN). When the GPRS device dials up, the carrier will assign a private IP address which is on the same network segment as the host and can maintain bi-directional communication using a polling architecture. Many enterprise clients turn to mobile virtual network operators (MVNO). These MVNO's acquire numerous GPRS services and then rents them out to customers who are looking for a small number of IP addresses.

Unfortunately, some countries do not have MVNOs, and some carriers do not provide VPN services. For this reason, this solution may be unfeasible for some users.

Aeroqual has used www.wyless.com successfully to communicate with AQM instruments.

Solution 3: DDNS

Using dynamic IP addresses is often necessary since many ISPs do not provide static IP addresses. The Dynamic Domain Name System (DDNS) is used to convert a device's name into a dynamic IP address so that remote devices can communicate with the control centre using a fixed domain name. DDNS takes care of the Dynamic IP address of a device, and DNS the static IP address of a device.

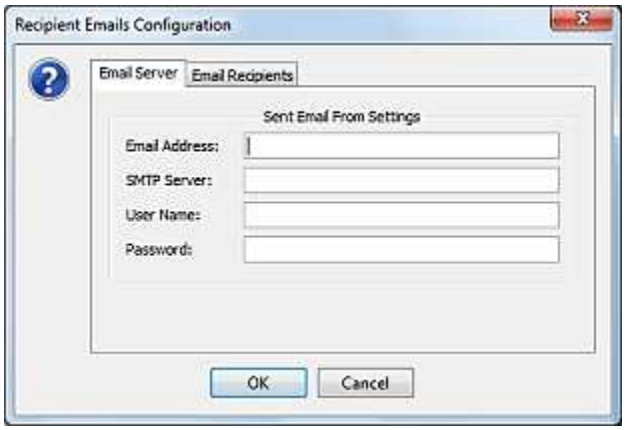
With most remote GPRS devices, you need to apply for a hostname for each of the devices handled by the DDNS server. When GPRS devices get an IP address from the carrier, they will automatically connect to the GPRS network. Each time a GPRS device's built-in DDNS client gets a new IP address, it will send the IP address to the DDNS sever.

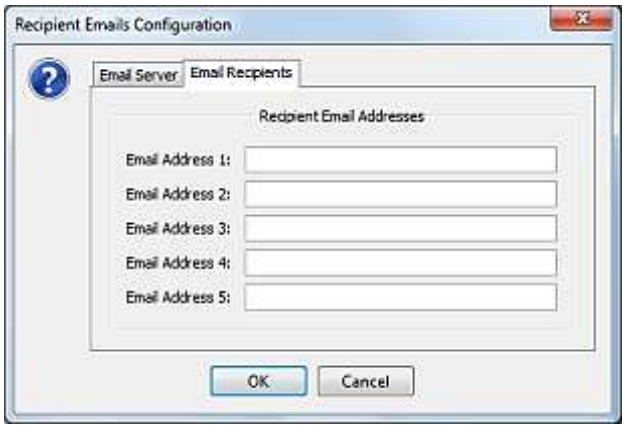
Aeroqual has integrated the "DynDNS Pro" service from http://dyn.com with your GateTel modem. For a small annual fee you can configure up to 30 host names to use with up to 30 modems.

3.3.2. Email Message

This function assumes the modem is fitted and correctly configured. It is activated by the "Enable Email Alert" tick box under Operations. Up to 5 Email recipients can be connected at once.

- Select Setup → Email Recipients and enter the Email server and Email recipients
- NOTE: the SMTP server will typically be one provided by your SIM card provider. The user name and password are often not required.



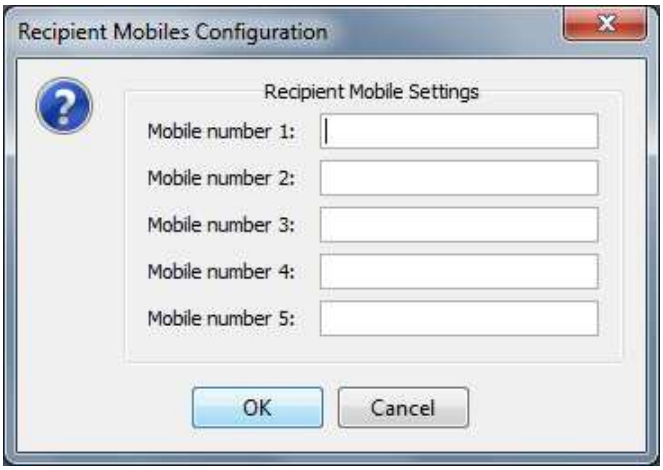


3.3.3. SMS Message

This function assumes the modem is fitted and correctly configured. It is activated by the "Enable SMS Alert" tick box under Operations. Up to 5 SMS recipients can be connected at once.

- Select Setup → Mobile Recipients and enter the relevant mobile phone numbers

Note: The country code needs to be included e.g. +44



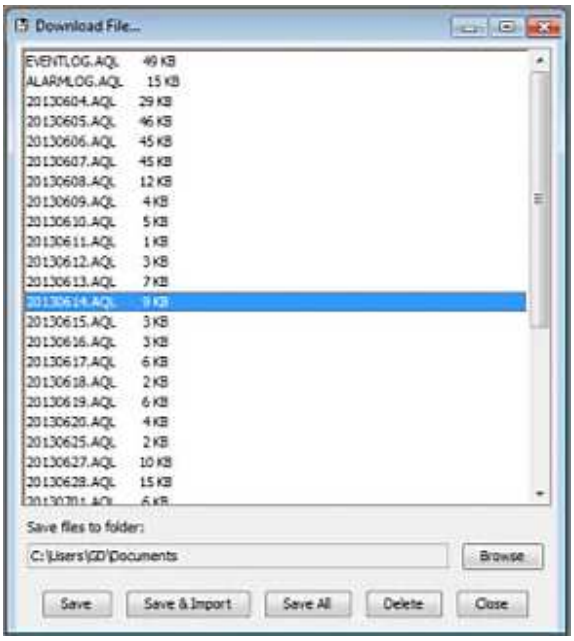
3.4. Software Description Summary

The Dust Sentry Software is designed to be a simple interface for communicating with the Dust Sentry monitor via a PC. It can be used to configure the instrument, initiate the zero calibration routine, modify gain factors, poll data and display the data in either table or graphical format. The software runs in Java VM1.5 (supplied with software) and the database is an open source HSQLDB Java database. Data can be easily exported to a spread sheet for processing. The software also incorporates a TCP/IP modem connection which can be used to connect to and operate a Dust Sentry unit remotely.

3.4.1. File

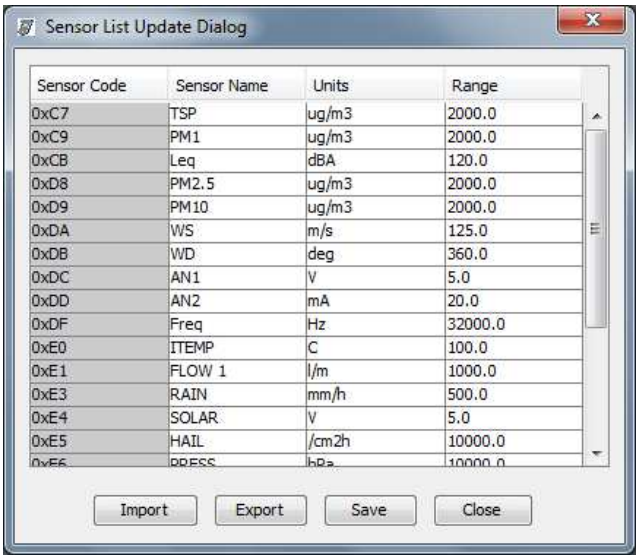
Search monitor	Searches for available Dust Sentry monitors
Connect to Monitor	Connects to Dust Sentry
Start Data Logging	Starts data logging from the Dust Sentry
Stop Data Logging	Stops data logging from the Dust Sentry

Export Logged Data	Exports logged data from the Dust Sentry
Import Files	Imports file (aql file)
Download Files	Downloads files; including daily files and event log



Note: Files can be either saved to the PC only by clicking Save/Save all or saved to the PC and the database by clicking Save & Import

Update sensor list	Update the sensor list on the database (Manual modification only available in Engineer Mode)



Note 1: Double click on the sensor name, unit or range to be modified and enter the new information. Click save once modification is complete.

Note 2: The changes made will modify the title headings in the logged data; it will not alter the readings. This is particularly useful for when AN1 and AN2 are being used.

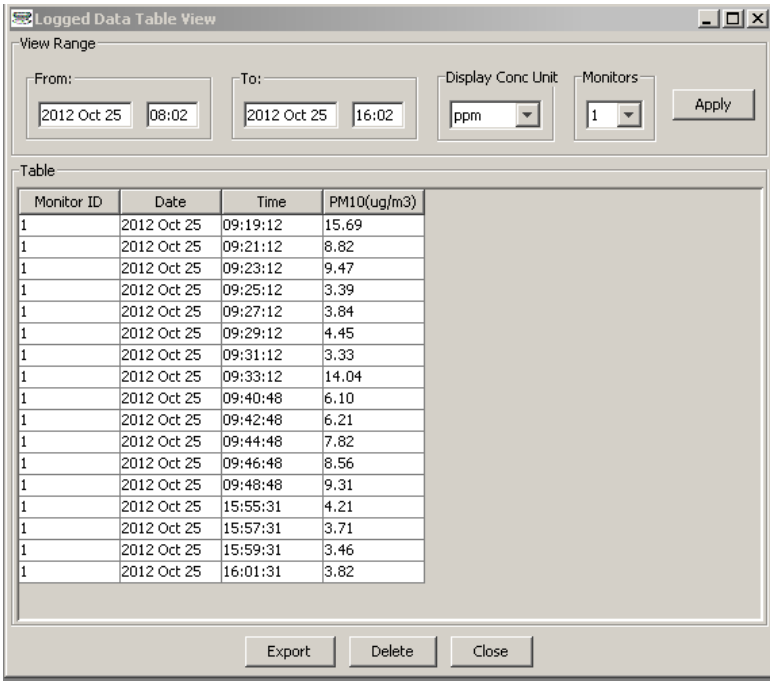
Zip database	Zips the database
Unzip database	Unzips the database (prompted by a warning message)
Exit Ctrl X	Exits the Dust Sentry software

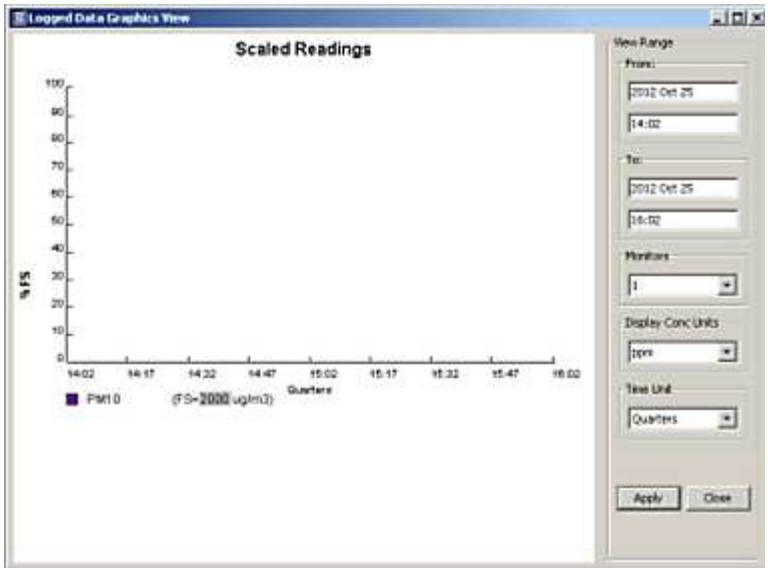
3.4.2. Setup

Configuration	Configures Monitor ID, Sensor Modules and Measurement Units
Operations	Configures the Data logging interval and Alarm and Analogue Output functions
Test Connection	Tests the connection to the Dust Sentry
Configure GPRS Modem	Configures the SIM card properties and operating mode of modem
Mobile Recipients	Configures mobile SMS alerts
Email Recipients	Configures email alerts
Communication Port	Allows setup of the serial COM port and TCP/IP port to communicate with the Dust Sentry

3.4.3. Data

Graph → Real Time	Graphs real time data from the Dust Sentry
Graph → Logged Data	Graphs Logged data from the Dust Sentry
Table → Real Time	Tabulates the real time data from the Dust Sentry
Table → Logged data	Tabulates the logged data from the Dust Sentry



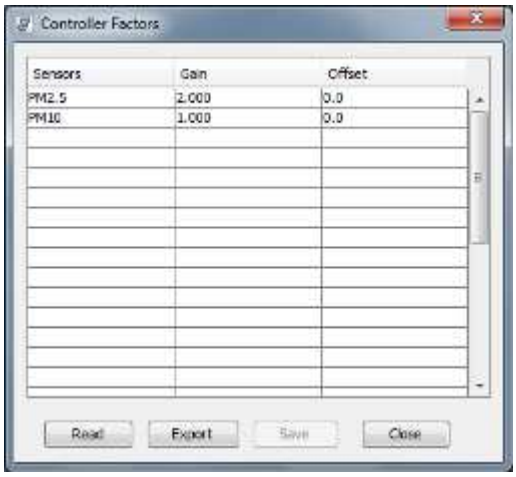


3.4.4. Tools

View Configuration	Views the configuration settings of the Dust Sentry
Poll Data (Ctrl D)	Polls data from the Dust Sentry (data will appear either in the real time table or real time graph depending on which is open)
Switch User	Change from User to Engineer mode
Change Login User Password	Changes the password required for User login
Update Real Time Clock	Updates the real time clock to that of the computer (prompted with a confirmation message)
Reset Timer	Resets the timer
Reset Controller	Performs a software reset of the Dust Sentry Control Module

3.4.5. Calibration

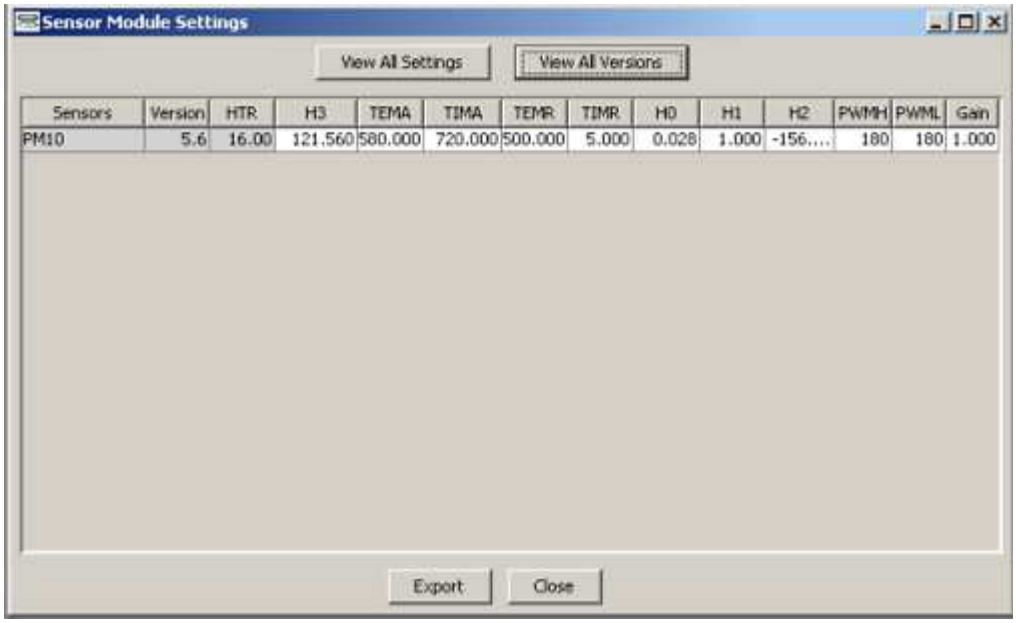
Control Factors	Displays the Dust Sentry's Gain and Offset factors
Zero Calibration	Initiates the zero calibration.



Note: The Gain and Offset can be modified manually by double clicking the unit to be changed, entering the new value and clicking save.

3.4.6. Diagnostics (Available in Engineer Mode)

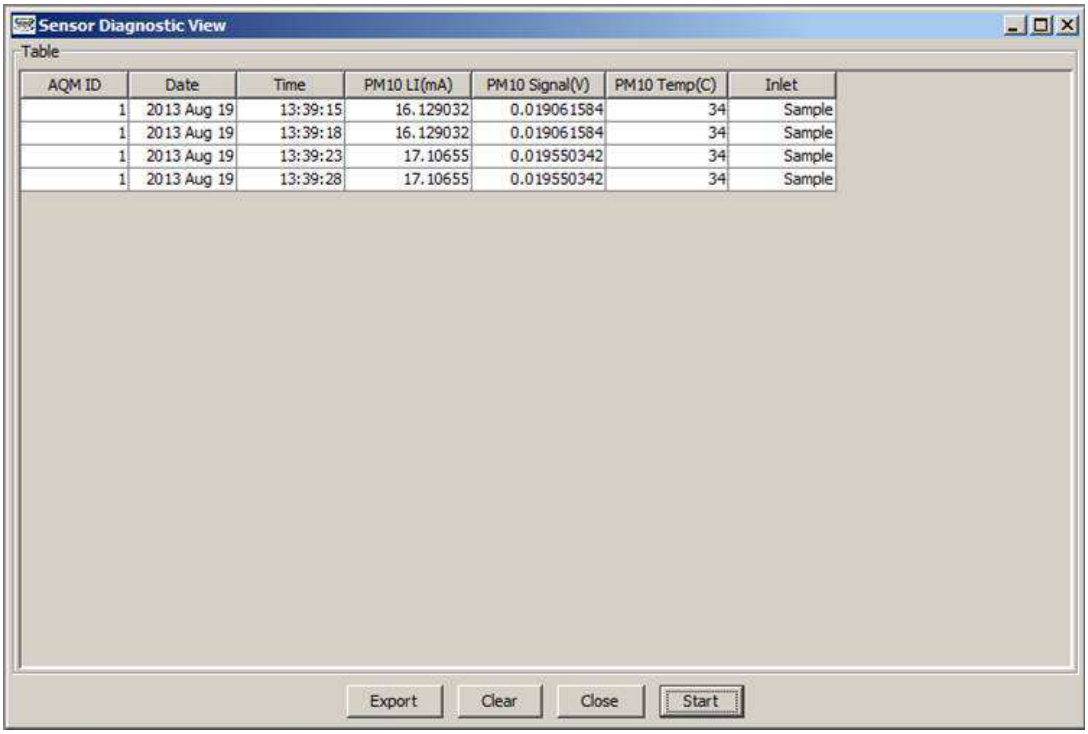
Sensor Module Settings	Displays the sensor module settings. Click on download all to display the module settings if not automatically downloaded. (exportable to text file)



Parameter	PM10	Meaning
Version	5.8	Firmware version (software controlling instrument operation)
HTR	16	Not used
H3	101.78	Calibration parameter taken from Met One calibration certificate (Bx100)
TEMA	580	Not used
TIMA	720	Auto zero timing (minutes)
TEMR	500	Not used
TIMR	5	Auto zero cycle time interval (minutes)
H0	0.01	The baseline output of 80180 (V)
H1	1	Not used (fixed as 1)
H2	10.077	Calibration parameter taken from Met One calibration certificate (Mx1000)
PWMH	35	Not used
PWML	3	Factory Module Type. Do not modify
Gain	1	Factory Gain. Do not modify

Note: These are EXAMPLE settings; instrument will have slight variations depending on calibration and software version releases

Sensor Diagnostics View Displays the sensor module diagnostic view (exportable to text file)



Parameter	Meaning
PM10 Laser (mA)	Laser current stable (18 ±3 mA)
PM10 Volt (V)	Output in Volts (0 to 5V) will vary with concentration
PM10 STemp (C)	80180 engine temperature

4. Maintenance

4.1. Maintenance Schedule

Procedure	Section	Frequency
Sample Flow Check	4.2.1.	Monthly
Purge Flow Check	4.2.2.	Monthly
Sheath Flow Check	4.2.3.	Monthly
Manual Zero Air Check	4.2.5.	Monthly
Fibre Span Check	4.2.6.	Monthly
Laser current check	4.2.7	Monthly
Filter Changes	4.2.8.	6 to 12 months
Cyclone and Inlet Cleaning	4.2.9	3 Months
Cyclone Disassembly	4.2.9	12 Months
Optical sensor factory calibration	Contact Aeroqual	24 Months

Notes 1: Suggested intervals for maintenance procedures may vary with sampling intensity and environmental conditions.

Note 2: All checks should be carried out during the initial commissioning of the Dust Sentry

4.2. Maintenance Procedures

4.2.1. Sample Flow Check

A constant 2.0 LPM flow is essential to ensure the sharp cut cyclone is separating out the correct particle size to be measured e.g. PM10 or PM2.5. To measure the flow, remove the TSP head from the inlet and connect the volumetric flow meter to the top of the sharp cut cyclone using the adaptor supplied with the instrument. Ensure the flow meter is on a steady surface before reading the flow rate.

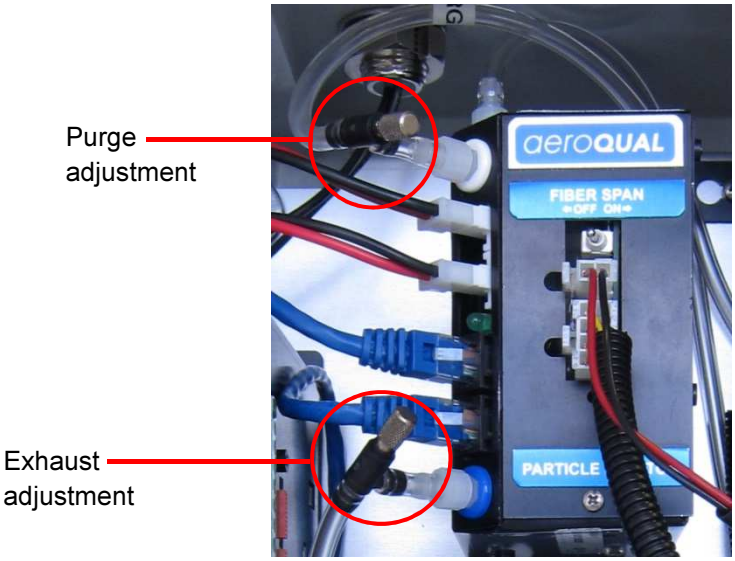
Note 1: The adaptor tubing should be connected to the TOP of the volumetric flow meter (negative flow)

Note 2: The flow should be 2.0 LPM

The PM inlet flow can be adjusted via the flow adjuster on the exhaust and purge line.

- If the flow is **less than** 2.0 LPM then **close the purge flow screw** (turn clockwise) until 2.0 LPM is achieved.
- If the flow is **greater than** 2.0 LPM then **open the purge flow screw** (turn anticlockwise) until the flow is 2.0 LPM.
- If you can't adjust the flow to 2 LPM using the purge flow screw then close (clockwise) the exhaust flow screw until 2.0 LPM is achieved.

Afterwards replace the inlet components with care, making sure there is no leak.



4.2.2. Zero Air Check (Purge Cycle)

The purge cycle is designed to pump air backwards through the optical engine as a cleaning mechanism. It also acts as a zero air check and adjusts the zero automatically. This will occur every 12 hours (720 minutes) automatically. To manually check the purge flow is operating correctly:

- Select Calibration → Zero Calibration

Use a volumetric flow meter to record the flow using the same steps as measuring the sample flow.

Note 1: The adaptor tubing needs to be connected to the BOTTOM of the volumetric flow meter (positive flow)

Note 2: The flow rate should be > 0.3 LPM

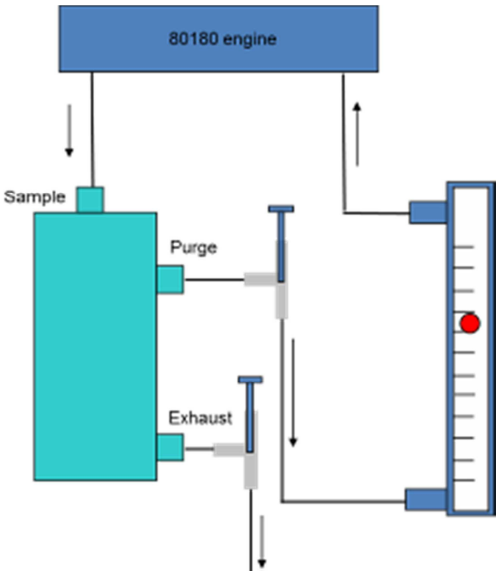
If the flow is less than 0.3 LPM then open the Purge Adjuster by turning the adjustment anti-clockwise until 0.3 LPM is reached.

Note 3: It may take a few moments for the purge cycle to complete. The unit can also be restarted to stop the purge cycle.

Note 4: It is important to re-measure the inlet sample flow rate following a purge flow adjustment. The sample flow rate must be stable at 2.0 LPM.

4.2.3. Sheath Flow Check

The sheath flow is a constant stream of air which ensures the optics remains clean. It is important this is working correctly to maintain the accuracy of the measurement. In order to check the flow, a volumetric flow meter needs to be connected between the purge flow adjuster and particle engine as seen in the diagram.



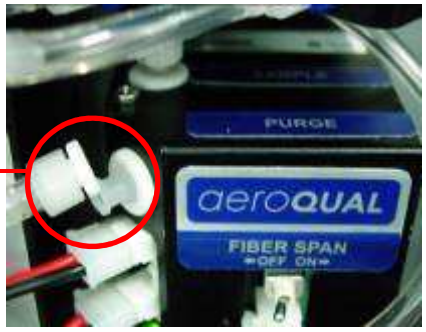
Note 1: The flow should be approximately 0.2 LPM

4.2.4. Leak Check

If the correct sample, purge or sheath flow cannot be achieved, there may be a leak in the pump module or 80180 engine. First check the entire flow system:

- Remove the purge connection from the module and plug the end of the purge line
- Remove the TSP head and block the PM inlet.
- Connect the pressure end of a flow meter to the exhaust port of the module.
- If there is no leak the flow should drop to zero.

Purge connection (remove to check whole flow system)



Sample connection (remove to check module)

If the flow does not drop to zero it suggests there is a leak somewhere in the system. To check the pump module:

- Keep the purge line disconnected.
- Remove the sample connection and cap off the module sample port.
- Connect the exhaust port of the module to the pressure end of a flow meter.
- The flow should drop to zero.

If there is a leak in the pump module the module will need to be sent back to the Aeroqual factory. Please contact technical support.

If there is no leak in the pump module check the tubing and connectors along the flow path carefully. If you cannot isolate the leak it is likely the leak is located in the engine. In this case, the engine will need to be sent back to the Aeroqual factory. Please contact technical support.

4.2.5. Manual Zero Air Check

A zero air check can also be carried out manually as a way to ensure the purge is working correctly. To do this the TSP inlet needs to be removed and the particle filter (supplied with the instrument) needs to be attached to the monitor. Ensure there is a good seal around the cyclone inlet.

The filter will remove 99.99% of particulates from ambient air. Wait 5 minutes and then check the readings on the control module. The reported value should be 0 +/- 3 µg/m3. If it is not then the auto zero cycle is not performing correctly. You will need to check the purge filter (Section 4.2.8) and replace if dirty and also check the purge flow to make sure it is correct.

4.2.6. Fibre Span Check

Perform a manual zero air check first, then initiate the fibre span by turning the switch on the Particle Monitor to on. The fibre span check is used to detect any major component failures such as the laser, photo detector or lens. Wait approximately 4 minutes until the measurement value increases and record the PM10 measurement from the controller. The fibre span measurement should be within ± 20% of the fibre span concentration noted in the logbook. If it is significantly lower, then either the module optics are dirty or the laser is ageing. Contact Aeroqual for advice

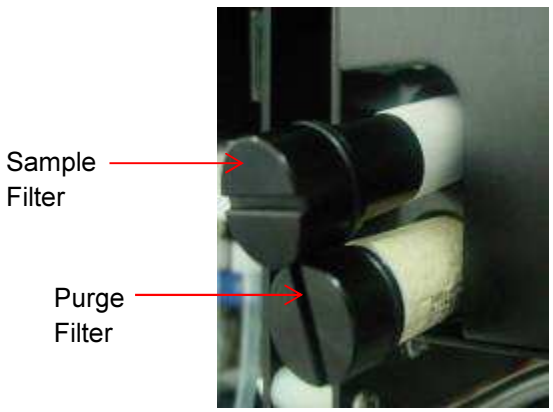
4.2.7. Laser Current Check.

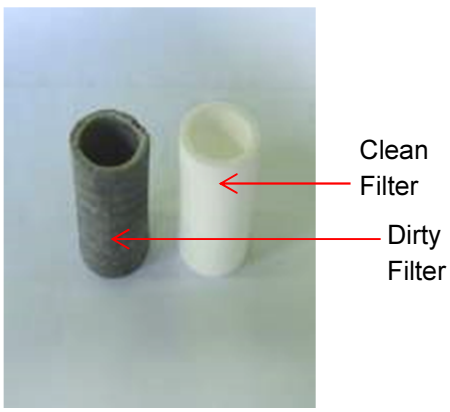
Refer to Section 3.4.6. to determine the laser current. If the laser current has drifted up or down by more than 3mA, the engine may need servicing; please contact Aeroqual for advice.

4.2.8. Filter Changes

There are two internal filters which are located on the side of the optical engine. They are designed to provide protection and to clean purge air. These will become dirty and must be replaced periodically.

To do this, unscrew the filters from the side of the optical engine and replace with new filters. These can be purchased from Aeroqual. Please contact technical support for a quotation.

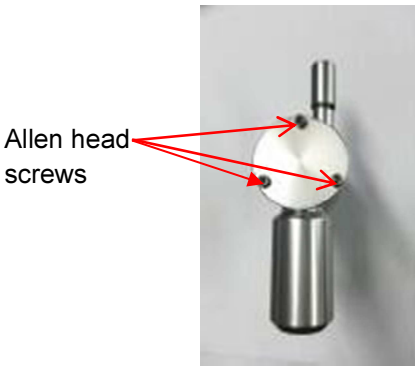




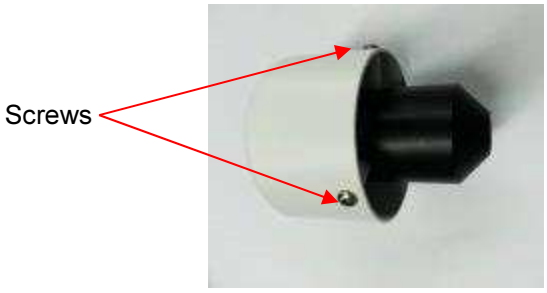
4.2.9. Cyclone and Inlet Cleaning

The dust cap of the sharp cut cyclone will accumulate particulate matter and will need to be periodically cleaned. Blow out the cyclone with compressed air and unscrew the dust cap and clean. Replace the cap tightly and ensure there are no potential leaks.

The cyclone can be disassembled completely by removing the three Allen head screws and pulling it apart. The internal parts should be cleaned with isopropyl alcohol once a year.



The TSP inlet can also be dismantled by unscrewing the 3 screws and separating the head into two parts. Use a lint-free cloth wetted with isopropyl alcohol to clean both the inside and outside of the inlet.



4.2.10. Pump Module Removal

The pump module can be removed from the Dust Sentry by unscrewing the 4 screws on the base plate and sliding the module out. Ensure the Dust Sentry is switched off when removing the module. The sample, purge and exhaust lines need to be disconnected and all the connected cables removed. The two main failures which would require removal of the pump module are:

1. A leak is discovered
2. The pump requires replacement

In both these cases the pump module will need to be sent back to the Aeroqual factory for repair. Please contact technical support for assistance.

5. Calibration

All particle monitors based on light scattering require a site calibration for optimum accuracy. This is because the average density and light scattering behaviour of dust particles will vary from site to site. This adjustment is sometimes known as a "K-factor". Aeroqual recommends a site calibration be performed at the time of initial installation and then every 12 months. Calibration is performed by co-locating the Dust Sentry with a Reference Particulate Matter measurement system and adjusting the Gain of the particle monitor so the average reading matches that of the Reference Instrument. A list of Reference instruments can be found at:
http://www.epa.gov/ttnamti1/files/ambient/criteria/reference-equivalent-methods-list.pdf
Install the Dust Sentry beside the Reference instrument. Make sure both instruments are setup correctly. Two procedures are given below depending on whether the reference instrument is a gravimetric or continuous instrument.

Procedure overview for Gravimetric Reference Instrument

1. Weigh a reference filter and install into the Reference instrument.
2. Leave the Dust Sentry and Reference instrument running for at least 24 hours until a weighable quantity of particulate matter sample has been collected.
3. Check the sample flows of both instruments to ensure they are within specification.
4. Remove the Reference filter and re-weigh
5. Download the Dust Sentry PM data for the calibration period.

Calculations

1. Reference Filter Weight of PM (ug):
   PM(Ref) = (filter weight at finish) – (filter weight at start)

2. Volume of air sampled by reference sampler (m3)
   Volume(Ref) = minutes of test * Flow Ref (LPM) / 1000

3. Calculate average reference PM density (ug/m3)
   AvPM(Ref) = PM(Ref)/ Volume(Ref)

4. Calculate average AQM60 PM (ug/m3):
   AvPM(Dust Sentry) = sum(PM readings over test period)/number of readings

Procedure overview for a Continuous Reference Instrument

1. Leave the Dust Sentry and Reference instrument running for at least 24 hours
2. Check the sample flows of both instruments to ensure they are within specification.
3. Download the Dust Sentry and Reference instrument data for the calibration period

Calculations

1. Calculate average Dust Sentry PM (ug/m3):
   AvPM(Dust Sentry) = sum(PM readings over test period)/number of readings

2. Calculate average Reference PM (ug/m3):
   AvPM(Ref) = sum(PM readings over test period)/number of readings

Calculation of Dust Sentry Gain

1. Calculate K factor
   K factor = AvPM(Ref) / AvPM(Dust Sentry)

2. You should then apply this to the Gain Factor on the PM channel.
   new GAIN = old GAIN x K Factor

6. Troubleshooting

Symptom	Possible Cause	Fault isolation/Solution
PM values seem incorrect	Sample flow incorrect	Check sample flow and adjust to correct value using flow adjusters
	Sample and/or purge filters dirty	Replace filters
	Gain factors incorrect	Perform span calibration
	Offset factor incorrect	Perform zero calibration
"NR" or "9999" in Data table(No response)	No Response from Sensor module. Not connected correctly.	Check the electrical connector on the sensor module is firmly connected
	Termination dongle not installed	Install termination dongle
Occasional NR or "9999" in Data Table	Bus cable	Check RS485 bus cable continuity
	Computer too slow	Test with a faster computer.
	RF noise in environment.	Try to reduce RF noise
Frequent "9999"	RS485 bus cable is faulty	Replace bus cable
	Module RS485 chip faulty	Remove one module at a time to identify faulty module and then replace.
	RF noise in environment.	Try to reduce RF noise
No communication over RS232	RS232 cable disconnected	Reconnect cable
	Control Module Failed	Replace Control Module
PC Data logging stopped	USB to serial hub not working	Check USB connectors. Check the serial hub is present on the device hardware menu in the PC. If not reload driver software and re-install.
No data on SD card	Card not correctly installed in slot.	Turn off Dust Sentry and install card in slot correctly.
	Data logging interval set too large.	Set logging interval in configuration to a lower interval.
	Data card module fault	Send control module to factory for replacement module.
IP Modem connection lost	SIM card account in debt	Pay SIM account
	Network down	Wait for network

	Signal strength low	Install high gain antenna or move instrument to site with better coverage.
Low Sensitivity	Laser is old The laser current can be measured in diagnostics mode using Dust Sentry software. If above 20 mA then fault	Laser needs replacing. Send to your authorised distributor or contact Aeroqual technical support.
Low Sensitivity	Dirty optics	Optics need cleaning Send to your authorised distributor or contact Aeroqual technical support.
High baseline (H0)	Dirty optics	Optics need cleaning Send to your authorised distributor or contact Aeroqual technical support.
Noisy Readings	Dirty optics Laser is old	Optics need cleaning Send to your authorised distributor or contact Aeroqual technical support. Laser needs replacing. Send to your authorised distributor or contact Aeroqual technical support.
Negative readings	Purge filter new and shedding particles Purge flow zero Purge filter dirty	Run zero cycles until purge filter no longer shedding particles. Adjust purge flow Replace purge filter
Fibre Span has changed significantly since installation	Dirty Optics Laser is old	Optics need cleaning Send to your authorised distributor or contact Aeroqual technical support. Laser needs replacing. Send to your authorised distributor or contact Aeroqual technical support.
Readings flat	Laser failed (check laser current) Photo-detector failed	Laser needs replacing. Send to your authorised distributor or contact Aeroqual technical support. Send optical engine to Met One for replacement detector and calibration.

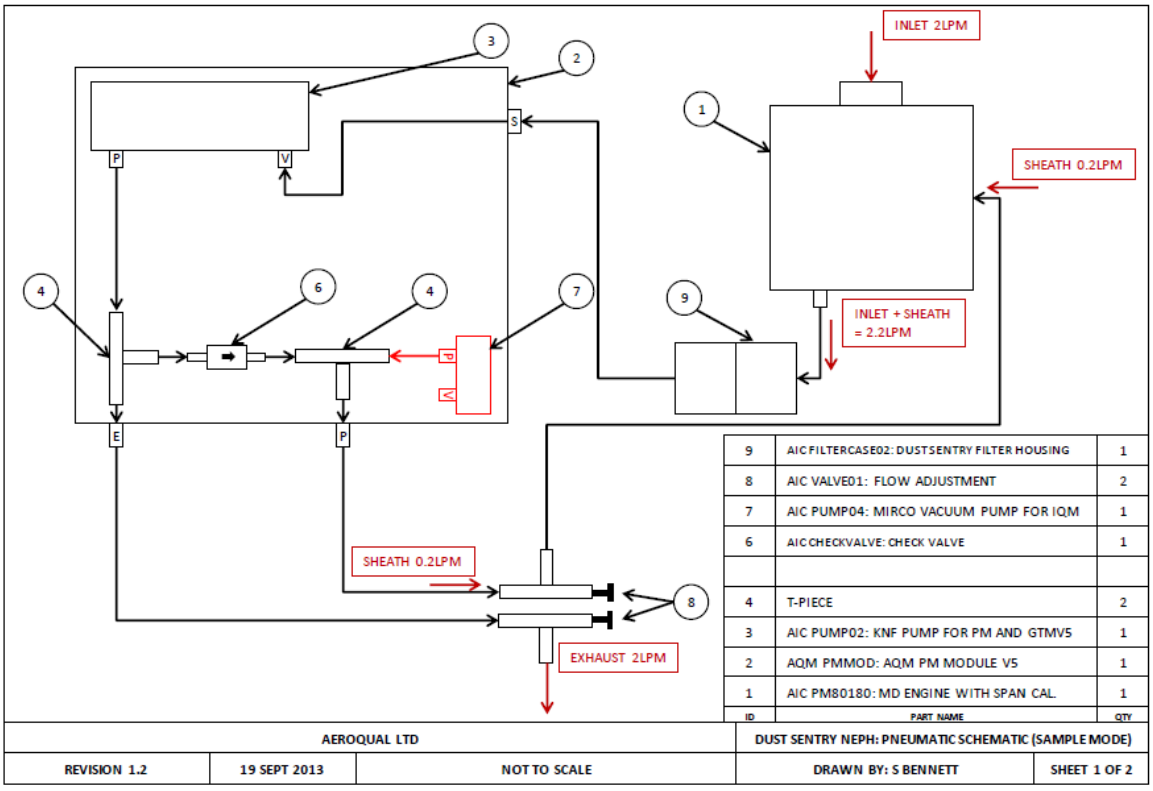
7. Specifications

Measurement technology	Near forward light scattering nephelometer
Range	0-2000µg/m^3
Accuracy	+/-(2 ug/m^3 + 5% of reading)
Cut points available	PM1, PM2.5, PM10 or TSP
Sample flowrate	2.0 LPM
Inlet	36cm heated inlet
Alarm	Relay, Email and SMS (Optional)
Data logging	2GB SD card (>15 years data storage)
Display	4 Line Alphanumeric
Output data units	µg/m^3
Averaging Period	1-60 minutes
Reference filter	47mm GFA circular filter (Optional)
Software	Data logging & configuration software included
Outputs	RS232, 4-20mA / 2-10V (optional)
Mounting	Pole, tripod or wall mounting
Wireless communication options	GSM/GPRS modem with GPS; Orbit DATA (cloud-based DAS)
Meteorological sensor options	Wind speed and direction; temp/RH; rain; pressure; noise (Class 1)
Environmental operating range	-10°C to +45°C; 0 to 95% RH (NC)
Power requirements	Power requirements Mains 100 - 260V, 18W (standard) or regulated 12 (+/- 2.5%) VDC with <150 mVp-p ripple and noise (15W)
Enclosure	IP65-rated Lockable GRP Cabinet: Width 330mm x Depth 187mm x Height 483mm (including solar shield armour & mounting brackets)
Weight	<12kg
Conformity	ISO 9001 www.intlcert.com FC CE C
Certification (Applied for)	mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

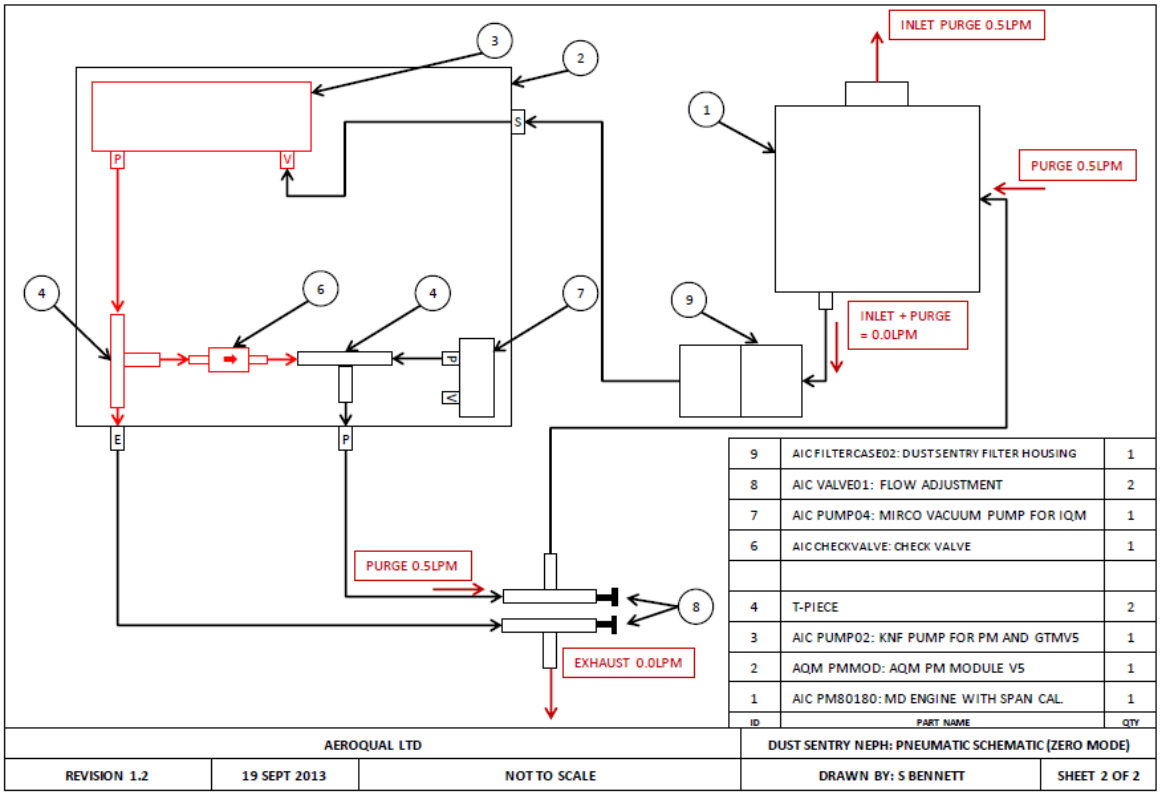
8. Schematic Diagrams

8.1. Pneumatics

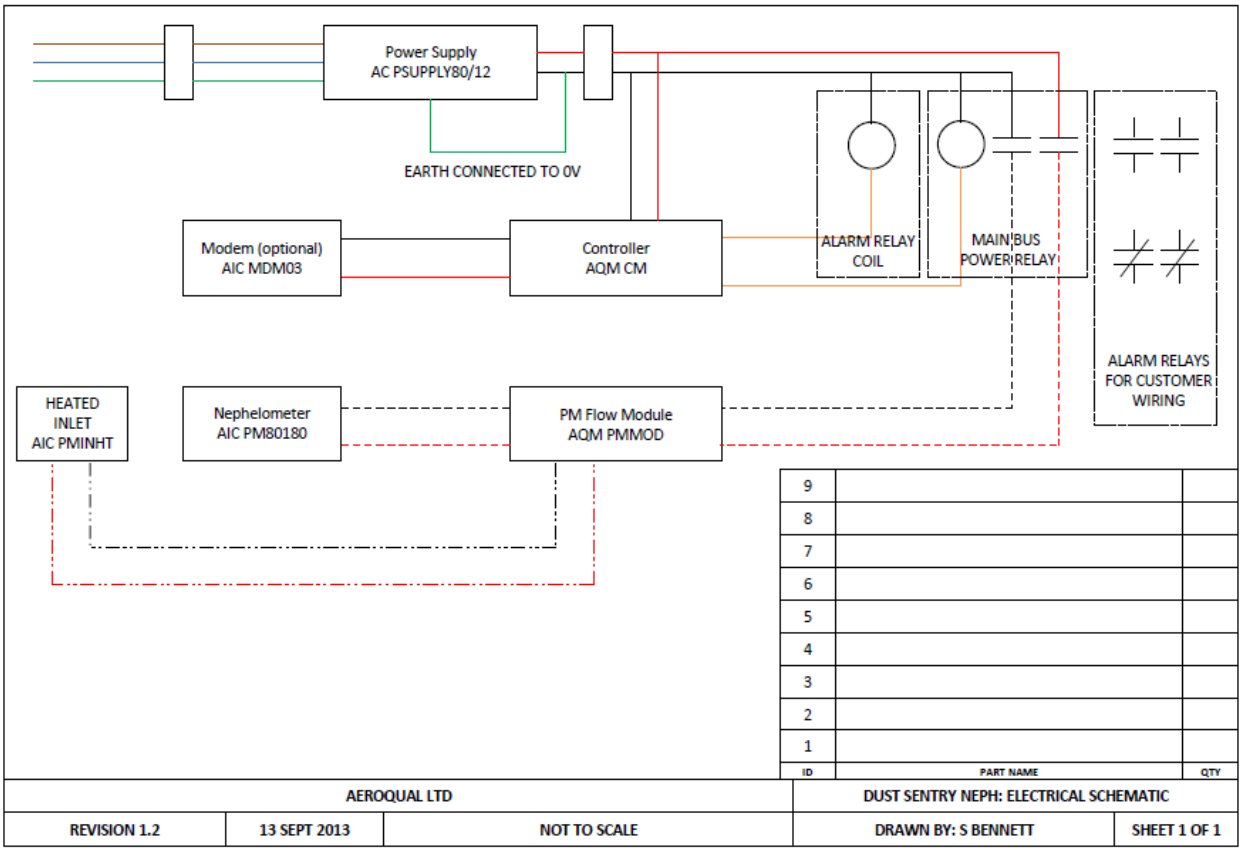
8.1.1. Sample Mode


INLET 2LPM
SHEATH 0.2LPM
INLET + SHEATH = 2.2LPM
SHEATH 0.2LPM
EXHAUST 2LPM
9 AIC FILTERCASE02: DUSTSENTRY FILTER HOUSING 1
8 AIC VALVE01: FLOW ADJUSTMENT 2
7 AIC PUMP04: MIRCO VACUUM PUMP FOR IQM 1
6 AIC CHECKVALVE: CHECK VALVE 1
4 T-PIECE 2
3 AIC PUMP02: KNF PUMP FOR PM AND GTMV5 1
2 AQM PMMOD: AQM PM MODULE V5 1
1 AIC PM80180: MD ENGINE WITH SPAN CAL. 1
ID PART NAME QTY
AEROQUAL LTD
DUST SENTRY NEPH: PNEUMATIC SCHEMATIC (SAMPLE MODE)
REVISION 1.2
19 SEPT 2013
NOT TO SCALE
DRAWN BY: S BENNETT
SHEET 1 OF 2

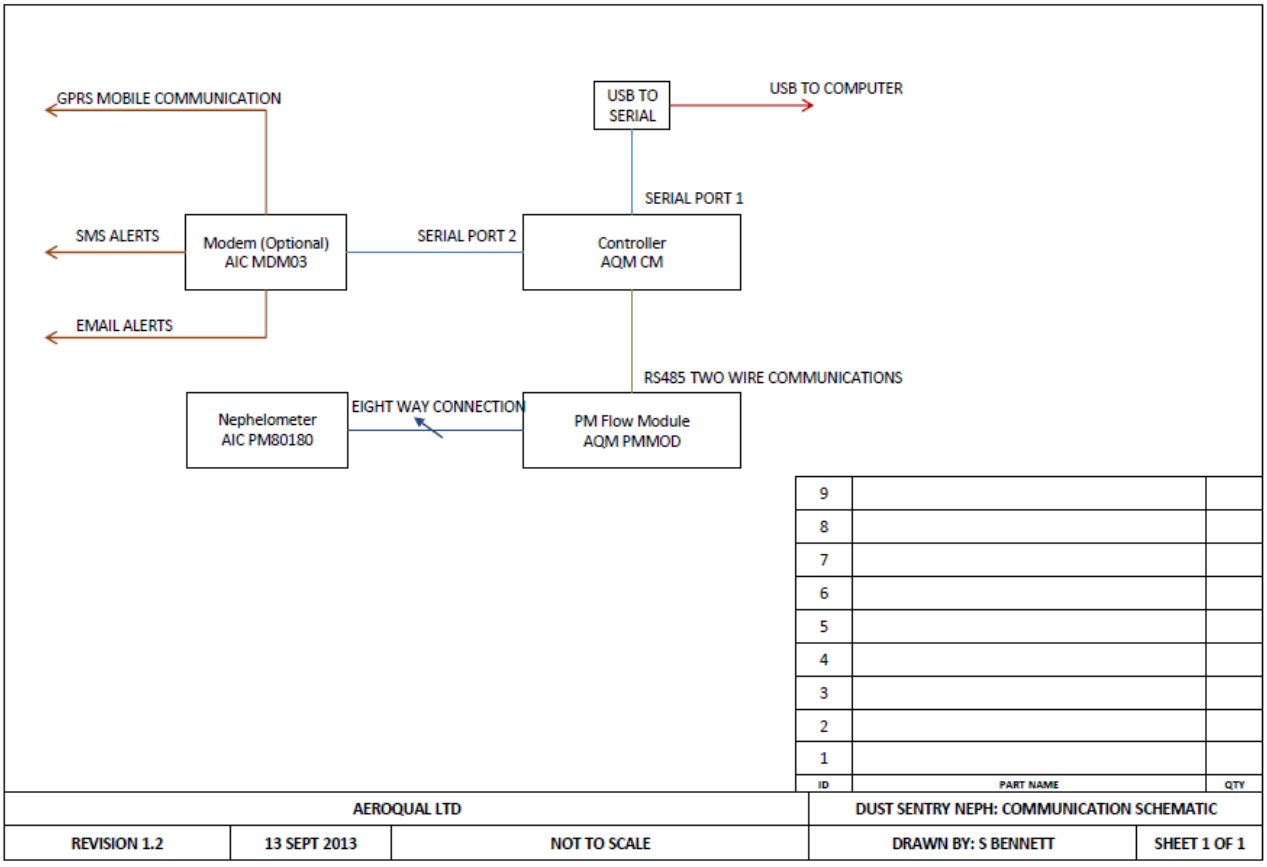
8.1.2. Zero Mode


INLET PURGE 0.5LPM
PURGE 0.5LPM
INLET + PURGE = 0.0LPM
PURGE 0.5LPM
EXHAUST 0.0LPM
9 AIC FILTERCASE02: DUSTSENTRY FILTER HOUSING 1
8 AIC VALVE01: FLOW ADJUSTMENT 2
7 AIC PUMP04: MIRCO VACUUM PUMP FOR IQM 1
6 AIC CHECKVALVE: CHECK VALVE 1
4 T-PIECE 2
3 AIC PUMP02: KNF PUMP FOR PM AND GTMV5 1
2 AQM PMMOD: AQM PM MODULE V5 1
1 AIC PM80180: MD ENGINE WITH SPAN CAL. 1
ID PART NAME QTY
AEROQUAL LTD
DUST SENTRY NEPH: PNEUMATIC SCHEMATIC (ZERO MODE)
REVISION 1.2
19 SEPT 2013
NOT TO SCALE
DRAWN BY: S BENNETT
SHEET 2 OF 2

8.2. Electrical



8.3. Communication



9. Third Party Sensors

9.1. Sensirion T/RH Sensor SHT75

Description: Measures air temperature and relative humidity

Specifications For full details visit the company website www.sensirion.com

Air Temperature	
Range	-40°C to + 124°C
Accuracy	±0.3°C
Resolution	0.01°C
Relative Humidity	
Range	0-100 %RH
Accuracy	±2 %RH
Resolution	0.1 %RH

9.2. Gill WindSonic

Description: 2-axis ultrasonic wind sensor, measures wind speed and direction

Specifications: For full details visit the company website **www.gill.co.uk**

Wind Speed	
Range	0-60 m/s
Accuracy	±2% @ 12 m/s
Resolution	0.01 m/s
Wind Direction	
Range	0-359° (no dead band)
Accuracy	±3% @ 12 m/s
Resolution	1 °
Mechanical	
External construction & protection	LURAN S KR 2861/1C ASA/PC; IP65
Size & Weight	142 x 160 (mm) ; 0.5 Kg
Environmental	
Operating range	-35°C to +70°C; <5% to 100% RH

9.3. Met One 034B

Description: 3-cup anemometer and vane designed to measure wind speed and direction

Specifications: For full details visit the company website www.metone.com

Wind Speed	
Range	0-75 m/s
Accuracy	±0.12 m/s @ < 10.1 m/s ±1.1% @ > 10.1 m/s
Resolution	0.7998 m/s
Wind Direction	
Range	Mechanical 0-360° Electrical 0-356°
Accuracy	±4°
Resolution	< 0.5°
Mechanical	
Finish	Clear anodized aluminum
Sensor Weight	0.81kg
Environmental	
Operating range	-30°C to +70°C

9.4. Met One MSO

Description: Measures wind speed and direction; air temperature; relative humidity; and barometric pressure

Specifications: For full details visit the company website www.metone.com

Wind Speed	
Range	0-50 m/s
Accuracy	±2%
Resolution	0.1 m/s
Wind Direction	
Range	0-360°
Accuracy	±5°
Resolution	1°
Air Temperature	
Range	-40°C - +60°C
Accuracy	±0.5°C
Resolution	0.1°C
Relative Humidity	
Range	0-100%
Accuracy	±4%
Resolution	1%
Barometric Pressure	
Range	500-1100 mbars
Accuracy	± 2 mbars
Resolution	0.1 mbar

9.5. Vaisala Weather Transmitter WXT520

Description: Measures wind speed and direction; liquid precipitation; barometric pressure; air temperature; and relative humidity

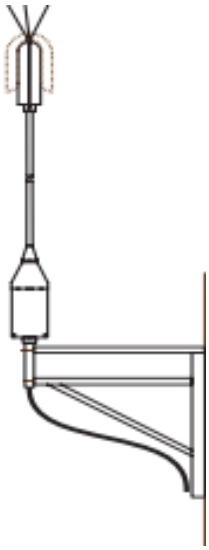
Specifications: For full details visit the company website www.vaisala.com

Wind speed and Direction	
Speed	
Measurement range	0-60 m/s
Accuracy	±0.3 m/s or ±3% (0-35 m/s); ±5% (36-60 m/s)
Direction	
Measurement range	0-360°
Accuracy	±3°
Liquid Precipitation	
Rainfall	cumulative accumulation after latest reset
output resolution	0.01 mm, 0.001 inches
accuracy	5%
Rainfall duration	counts each 10 s increment when droplet detected
output resolution	10 s
Rain intensity	one-minute running average in ten-second steps
range	0-200 mm/h
output resolution	0.1 mm/h, 0.01 inches/h
Barometric Pressure	
Measurement range	600-1100 hPa
Accuracy	±0.5 hPa @ 0 to 30 °C (+32 to +86 °F); ±1 hPa @ -52 to +60 °C (-60 to +140 °F)
Air Temperature	
Measurement range	-52 to +60 °C (-60 to +140 °F)
Accuracy @ +20 °C (+68 °F)	±0.3 °C (±0.5 °F)
Relative Humidity	
Measurement range	0-100 %RH
Accuracy	±3 %RH (0-90 %RH); ±5 %RH (90-100 %RH)

9.6. Cirrus MK:427

Description: Class 1 outdoor noise meter

Specifications: For full details visit the company website
www.cirrus-environmental.com



Output Type	'A' weighting SPL output in the form of a 4-20mA loop
Frequency Weighting	dB(A) to IEC 61672-1:2002
Time Weighting	Factory set to Fast ('F') IEC 61672-1:2002
Automatic Calibration	Electrostatic Actuator System with DC voltage control
Measurement Range	30 – 100dB(A)
Current Loop Output	Iout = 0.1mA/dB
Dimensions	1m length
Weight	4.5 Kg
Mounting	240mm x 30mm diameter pole Mounting Kit provided (2 U-brackets, 4 nuts, 3 Jubilee Clips)
External Power	+12V DC in
Output Cable	10m as standard

10. Mounting and Site Positioning Guidelines

It is important that the positioning of the Dust Sentry is suitable so as to yield data which is representative of that specific location.

10.1. Mounting

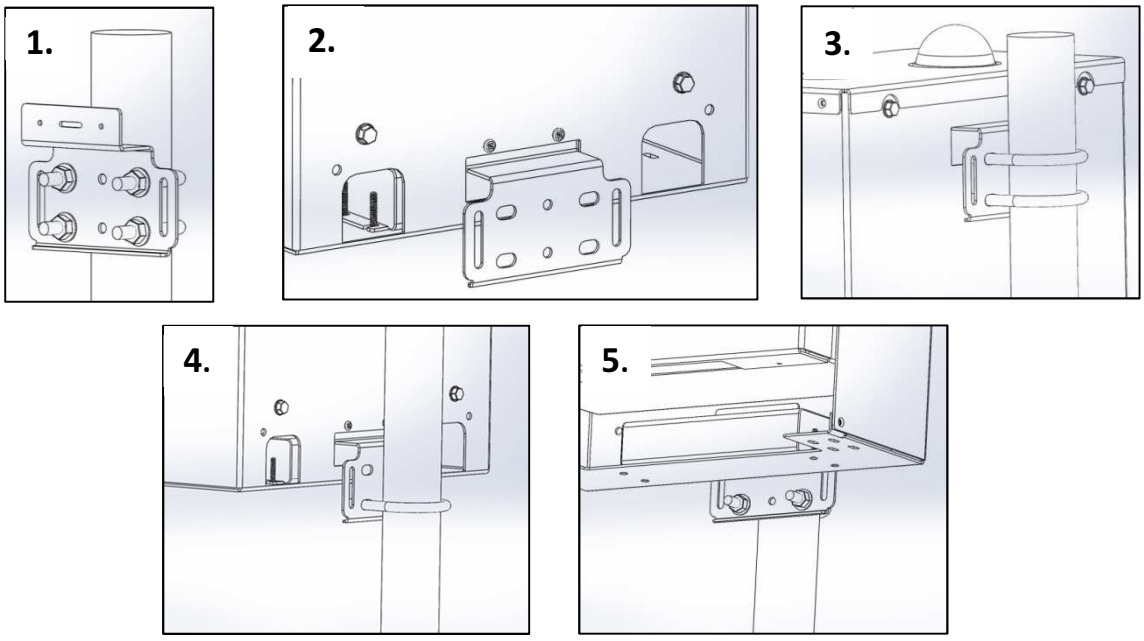
The Dust Sentry comes with 2x mounting brackets and 3x U-bolts for 2 inch poles. The same brackets are used for both pole and wall mounting. To wall mount the Dust Sentry the brackets are screwed into the wall instead of using the U-bolts.

For pole mounting:

1. Secure top mounting bracket at a suitable height using 2x U-bolts provided
2. Fix lower mounting bracket to the Dust Sentry chassis with screws
3. Hang the Dust Sentry on the top mounting bracket
4. Place U-bolt through lower mounting bracket

Note: Only one U-bolt is used to secure the bottom bracket

5. Add nuts and washers and tighten the bottom U-bolt into position



10.2. Inlet height

- If PM monitoring is related to human exposure, the sampling inlet height should be positioned in the “breathing zone”. This is located between 2 and 15 meters above ground level.
- If PM monitoring is related to specific emission sources, the position of the sampling inlet can be more flexible. It is more important that there is no obstruction between the approaching air from the emission source and the sampling inlet.
- If more than one Dust Sentry, or any other particulate instrument, is being used at the site, the height of the inlets should be uniform.
- If the Dust Sentry inlet is the highest point at the site, a lightning rod must be installed to prevent damage to the unit during electrical storms.

10.3. Measurement Interference

- The meteorological conditions of the site should be taken into consideration when positioning the Dust Sentry. For example, there should be no obstruction to the air flow in the predominant wind direction. A minimum clear sky angle of 120 degrees is recommended.
- The inlet should be at least 1 meter away from any objects that could potentially influence the airflow characteristics e.g. trees, vertical surfaces or walls.
- Avoid overhead high-voltage cables which may cause electrical interference with the sampling equipment.
- Demolition/construction activities and change to normal transport patterns due to road works etc. can significantly affect the data. Ensure a record of such events is kept to account for unexpected peaks in concentration.

10.4. Safety

- The intended data capture rate should be considered when positioning the Dust Sentry. If data capture above 90% is essential, the unit should be located in an area which has 24 hour access available.
- The positioning should allow for routine maintenance checks to be performed safely by personnel.
- If using a tripod, ensure the tripod legs are bolted to the ground to prevent the unit from falling. Ensure the Dust Sentry is in a secure location to avoid vandalism or theft.

11. Orbit Data

Orbit data is a cloud-based data acquisition and reporting system developed specifically for Aeroqual's real-time air quality instruments. Using Orbit, customers are able to access their data online and in real time. The system comprises a proprietary modem which plugs directly into the serial port of your instrument. The modem pushes data to the cloud-based server at pre-determined intervals. Via orbitdata.com end users can access, view, and download the data using a browser on any internet enabled device.

11.1. Specifications

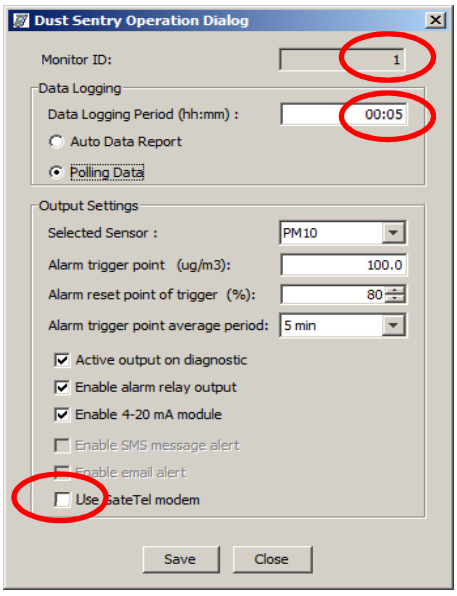
Modem	3G GSM/GPRS
SIM card	Global Sim supplied by Aeroqual KORE Telematics
Power requirements	5-30VDC, supplied by instrument
Input	RS232
Dimensions	149 x 81 x 31 (mm)
Environmental operating range	-20 to +70°C
Software	Web-based
Browser compatibility	Internet Explorer (7+), Chrome, Safari
Alarms	Unlimited text/SMS, email
Parameters	Up to 20, dynamically configurable
Data Warehouse	RAID, clustered storage, multi-site
Data Format	CSV, XML (FTP only)
Conformity	FC CE

11.2. Configuring the Orbit Modem

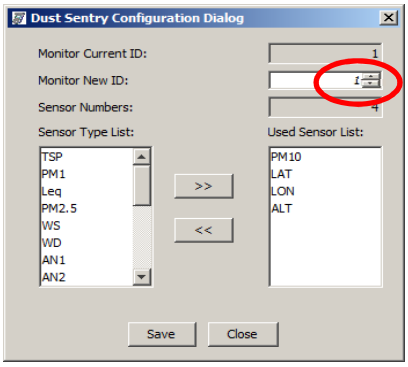
Aeroqual will provide a Serial Port Extender (SPE) which is a GSM/GPRS telemetry modem used at a remote location to connect between a remote device (with a serial port) and a central computer. The SPE is more than just a GPRS telemetry modem with an IP stack built in. It has many functions which ensure that the remote device is always able to communicate with the host system. Aeroqual also provides a Global SIM which is pre-installed.

To configure using the PC software:

- Select Setup → Operations
- Select Data Logging period to 5 minutes
- Select Polling Data
- Uncheck Use GateTel modem
- Click Save and Close



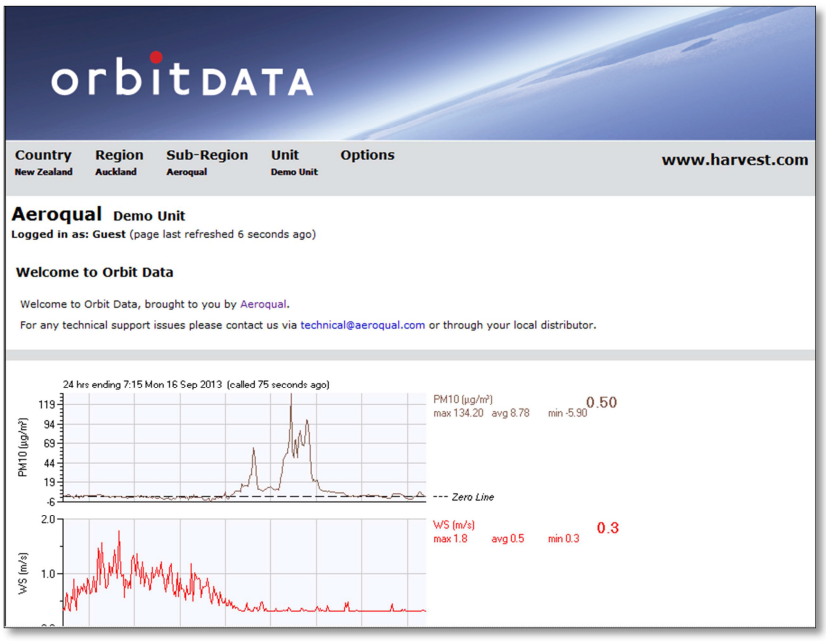
- Select Setup →Configuration
- Set Monitor ID to 1
- Click Save and Close



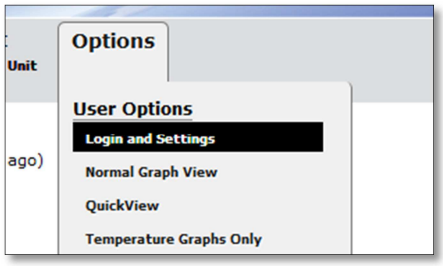
11.3. Using the Orbitdata Website

Once the Dust Sentry has been configured with the Orbit Modem the unit can be accessed via www.Orbitdata.com

- When the site is first accessed a default landing page will be shown

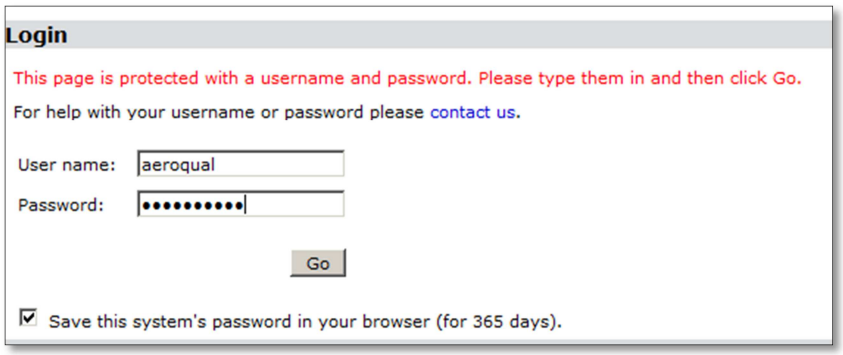


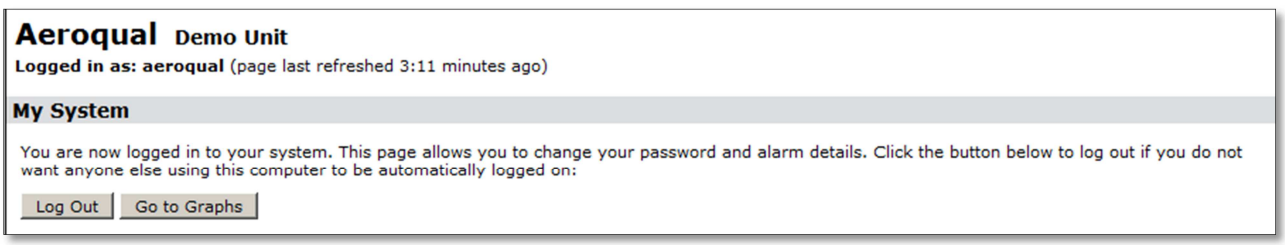
- Select Options → Login and Settings
- Enter your User Name and Password



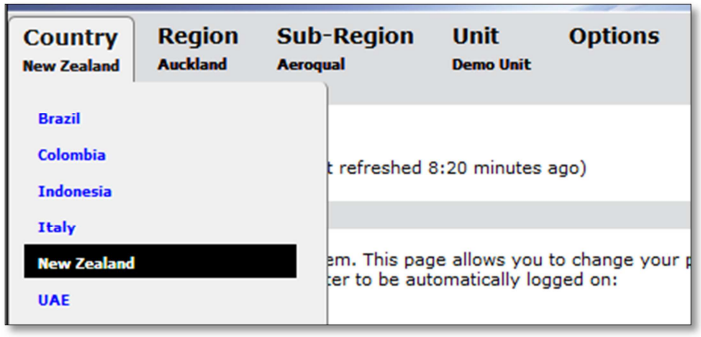
Note: You can elect to save the login details in your browser at this point

- The system displays "Logged in as: your name"
- Select Go to Graphs


Login
This page is protected with a username and password. Please type them in and then click Go.
For help with your username or password please contact us.
User name: aeroqual
Password:
Go
Save this system's password in your browser (for 365 days).


Aeroqual Demo Unit
Logged in as: aeroqual (page last refreshed 3:11 minutes ago)
My System
You are now logged in to your system. This page allows you to change your password and alarm details. Click the button below to log out if you do not want anyone else using this computer to be automatically logged on:
Log Out
Go to Graphs

- Navigate to your specific site and unit by:
  - Selecting the correct country from the drop down menu
  - Selecting the Region
  - Selecting the Sub-region
  - Selecting the Unit

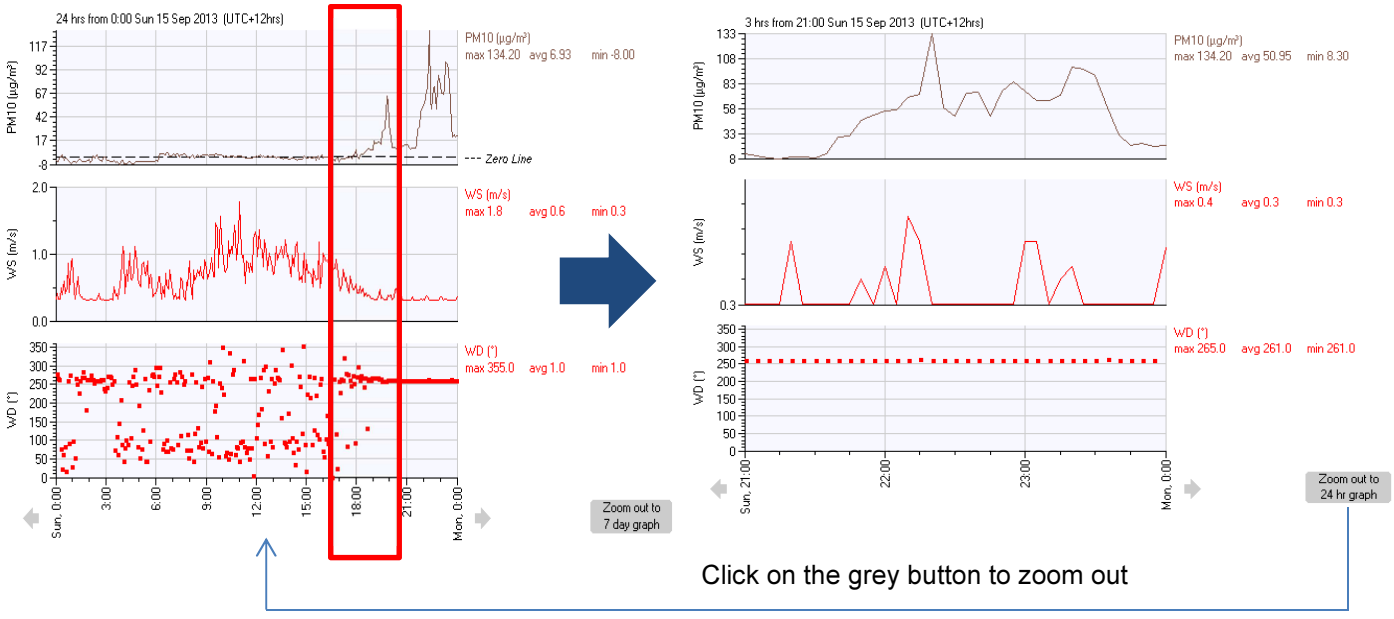


11.3.1. Using the Graphs

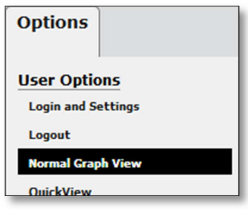
Once the correct unit has been selected the default 24 hour graphed data will be shown on the screen. Above the graphs it will show the time, date and how long since the unit was last called. To the right of each graph the max, min and average will be shown.

- Click on the graph to zoom in on a specific time interval.
  - Hover the mouse over the graph to view the start time and time interval of the graph to be shown if clicked e.g. “3 hr graph from 3:00pm Mon, 16 Sep 2013”.
  - To zoom out press the grey button in the bottom right e.g. “Zoom out to 7 day graph”

Note: The time intervals that can be shown are: 3 months, 1 month, 7 days, 24 hours, 3 hours, 1 hour and 15 minutes.


24 hrs from 0:00 Sun 15 Sep 2013 (UTC+12hrs)
PM10 (µg/m³)
max 134.20 avg 6.93 min -8.00
Zero Line
WS (m/s)
max 1.8 avg 0.6 min 0.3
WD (°)
max 355.0 avg 1.0 min 1.0
Zoom out to 7 day graph
3 hrs from 21:00 Sun 15 Sep 2013 (UTC+12hrs)
PM10 (µg/m³)
max 134.20 avg 50.95 min 8.30
WS (m/s)
max 0.4 avg 0.3 min 0.3
WD (°)
max 265.0 avg 261.0 min 261.0
Zoom out to 24 hr graph
Click on the grey button to zoom out

- To return to the default view (24 hours) click Options → Normal Graph View
- Other viewing options are: QuickView, Temperature Graphs Only, Latest Data in Text Format, Latest Weather, Smartphone View, and Historical Data.

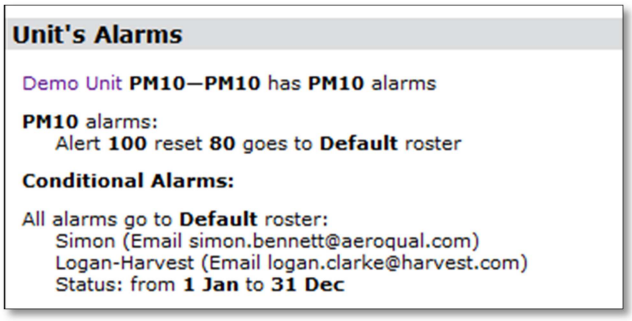


11.3.2. Setting Alarms

To set an alarm **email** Aeroqual at technical@aeroqual.com with the following information:

1. What triggers the alarm (e.g. PM10 concentration > 100ug/m3)
2. What clears the alarm (e.g. PM10 concentration < 80ug/m3)
3. Who to notify in the case of an alarm (e.g. Email sales@aeroqual.com or SMS +64 21 123 456)

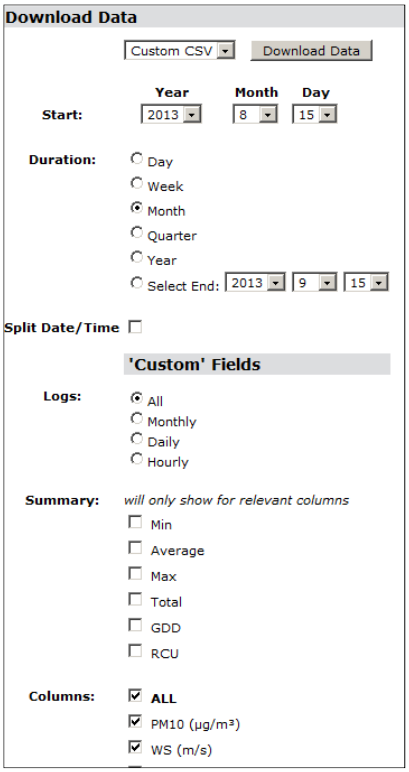
Once the alarms have been configured they are visible from the Options → Alarm Information view.


Unit's Alarms
Demo Unit PM10—PM10 has PM10 alarms
PM10 alarms:
Alert 100 reset 80 goes to Default roster
Conditional Alarms:
All alarms go to Default roster:
Simon (Email simon.bennett@aeroqual.com)
Logan-Harvest (Email logan.clarke@harvest.com)
Status: from 1 Jan to 31 Dec

11.3.3. Downloading Data

The data can be downloaded as a CSV file and opened in Excel from the Orbitdata website.

- Click on Options → Data Options → Download Data
- Select the Start Date, Duration and any other customised options required then click Download Data
- Open the file as an Excel Spread Sheet. The data will be displayed as seen below:



	A	B	C	D	E	F	G	H	I	J	K
1	Time (dd-	PM10 (µg/	WS (m/s)	WD (°)	Air Tempe	Air RH (%)	Pressure (	AN2 (mA)	AQ Temp	AQ RH (%)	Battery (V
2	########	-0.3	1.1	105	15.9	61.8	1010.6	4	28.6	40.2	11.4
3	########	0	1.3	297	15.8	62.7	1010.6	4	28.5	40.4	11.4
4	########	0.1	0.9	77	15.8	63.8	1010.6	4	28.4	40.6	11.4
5	########	0.9	1.3	81	15.7	63.6	1010.6	4	28.4	40.7	11.4
6	########	0.5	1.3	80	15.7	63	1010.6	4	28.3	40.9	11.4
7	########	0.9	0.6	358	15.7	63.9	1010.6	4	28.3	40.6	11.4
8	########	1.5	1	271	15.6	65	1010.6	4	28	39.1	11.4

12. Appendix

12.1. Warranty

Please review the Aeroqual Warranty Policy on our website at www.aeroqual.com

12.2. Technical Support

Technical information, service and spare parts are available through your distributor. In addition, worldwide technical support is available from Aeroqual Ltd. Please contact Aeroqual Technical Support by email: technical@aeroqual.com. This will generate an automatic ticket and your enquiry will be addressed as quickly as possible by a qualified service person.

Aeroqual Limited
109 Valley Road, Mt Eden, Auckland 1024, New Zealand
Phone: +64 9 623 3013
Fax: +64 9 623 3012
Email: technical@aeroqual.com

12.3. Declarations

Copyright Aeroqual Limited. All rights reserved. Reproduction, transfer, distribution or storage of part or all of the contents of this document in any form without the prior written permission of Aeroqual Limited is prohibited.

“Aeroqual” and “Aeroqual Limited – Making the Invisible Visible” are registered trademarks of Aeroqual Limited. Other product and company names mentioned herein may also be trademarks or trade names.

Aeroqual operates a policy of continuous development. Aeroqual reserves the right to make changes and improvements to any of the products described in this document without prior notice.

Under no circumstances shall Aeroqual be responsible for any loss of data or income or any special, incidental, consequential or indirect damages howsoever caused.

The contents of this document are provided "as is". Except as required by applicable law, no warranties of any kind, either express or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose, are made in relation to the accuracy, reliability or contents of this document.

Aeroqual reserves the right to revise this document or withdraw it at any time without prior notice. The availability of particular products may vary by region. Please check with the Aeroqual dealer nearest to you.

© Aeroqual Limited 2013. All rights reserved.

1. The Aeroqual Dust Sentry complies with EN 61000-6-1:2001
2. The Aeroqual Dust Sentry complies with EN 61000-6-3:2001
3. The Aeroqual Dust Sentry complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) these devices may not cause harmful interference, and (2) these devices must accept any interference received, including interference that may cause undesired operation.
4. The Aeroqual Dust Sentry is pending MCERTs for indicative ambient particulate monitor

- **USE SENSIBLY**
  Use the Aeroqual DUST SENTRY instrument only as per this user guide.

- **USE AEROQUAL APPROVED SERVICE**
  Only approved service personnel must work on this product.

- **ACCESSORIES**
  Use only approved accessories. Do not connect incompatible products.

- **CONNECTING TO OTHER DEVICES**
  When connecting to any other device, read the appropriate user guide for detailed safety instructions. Do not connect incompatible products.